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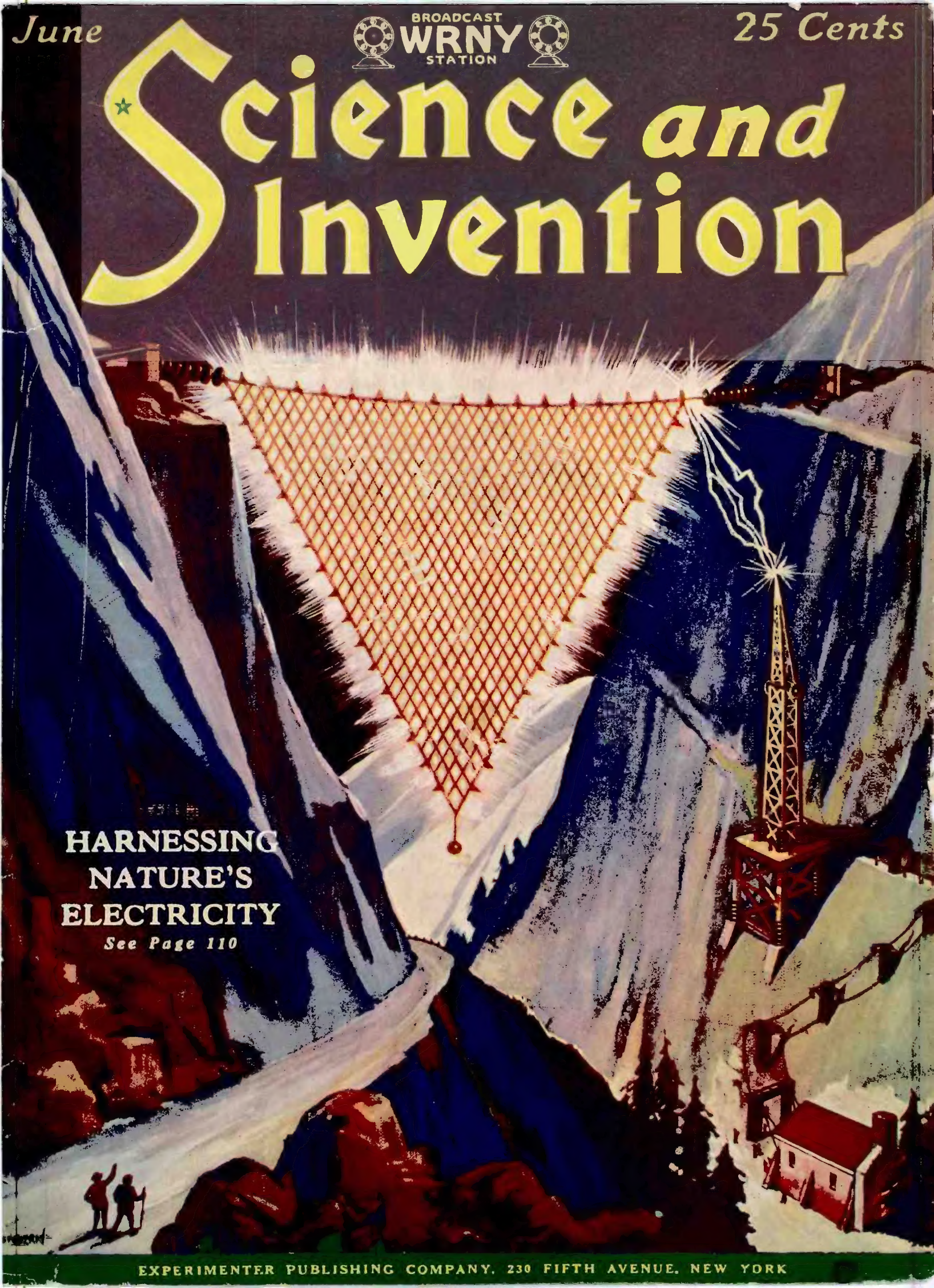

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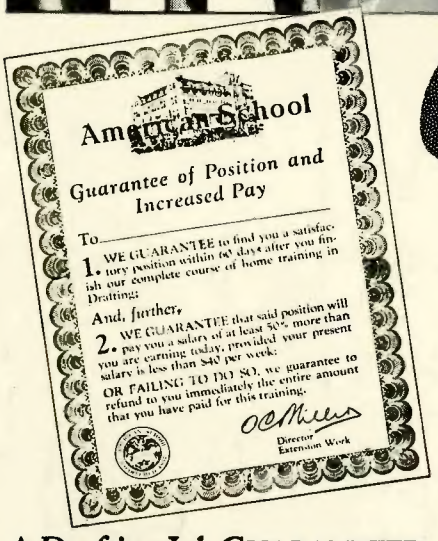
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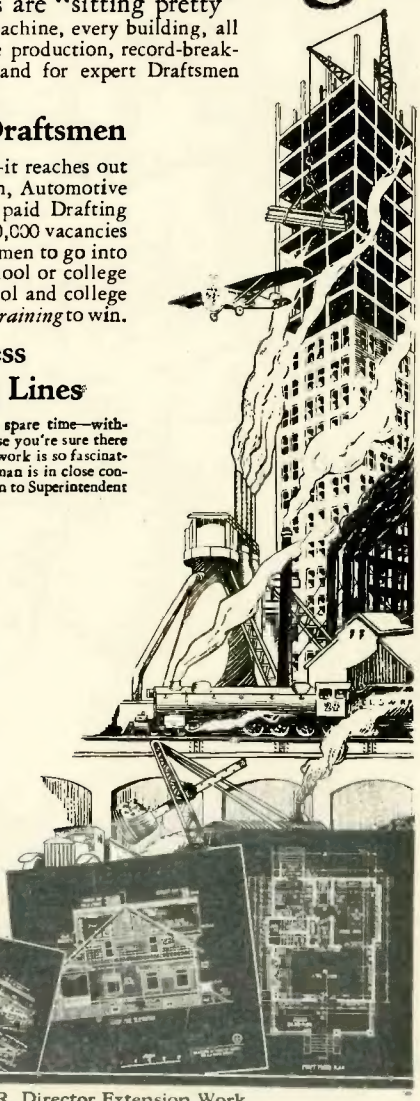

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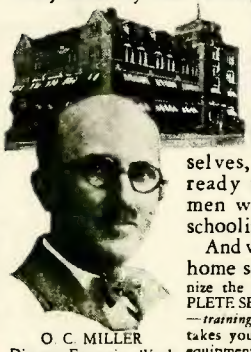

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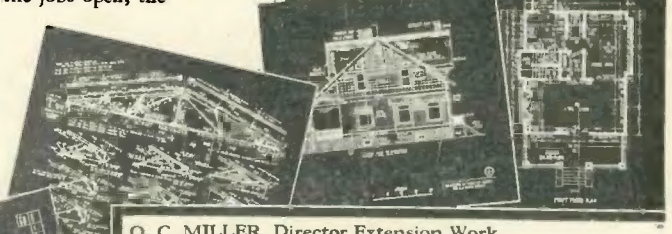

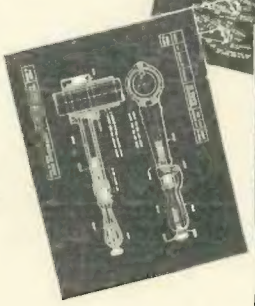

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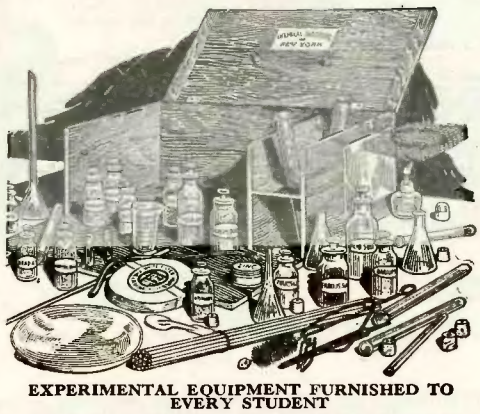

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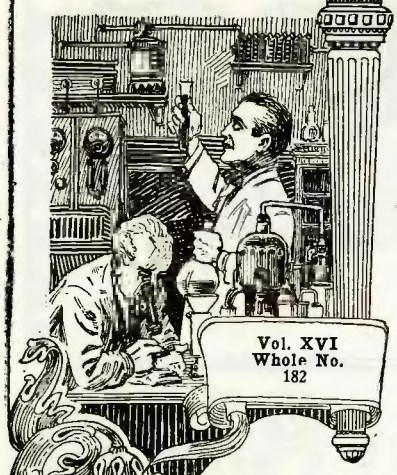

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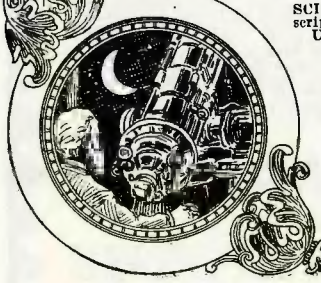

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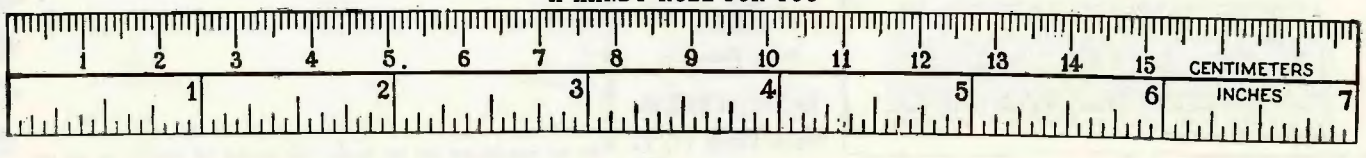

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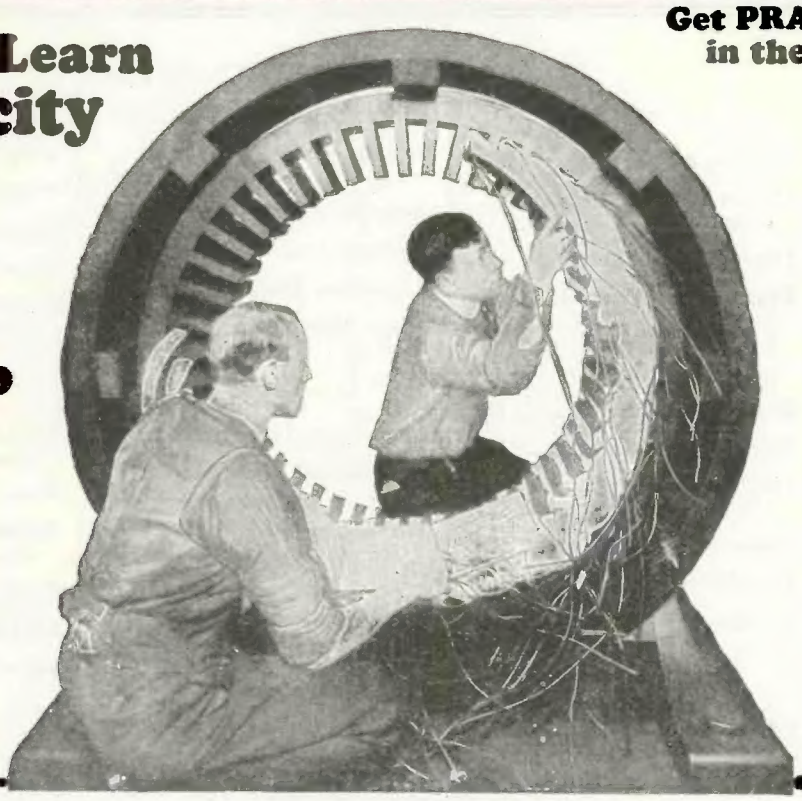

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7 P.M.~Rushes supper to tune in big DX,
7 30~Discovers set wont work,
9 P.M.~Still trying to locate trouble,
12 P.M. Gives up in disgust!

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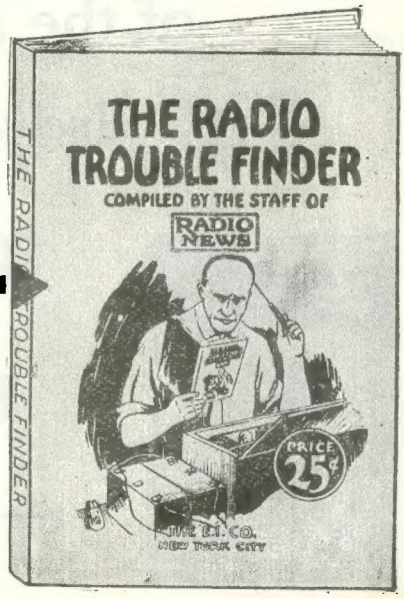


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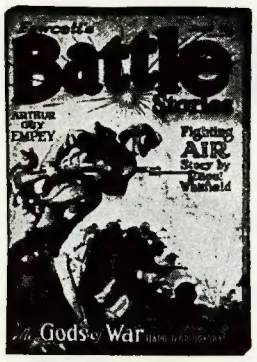


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Volume XVI
Whole No. 182

Science and Invention

June, 1928
No. 2

HUGO GERNSBACK, *Editor-in-Chief*
H. WINFIELD SECOR, *Managing Editor*
DR. T. O'CONOR SLOANE, PH.D., *Associate Editor*
Editorial and General Offices - - - - - - - - 230 Fifth Avenue, New York

*"Those Who Refuse to Go Beyond Fact Rarely Get as Far as Fact"* - - - - - - - - - - - - - - - *HUXLEY*

# INTER-PLANETARY COMMUNICATION

By HUGO GERNSBACK

WHEN we talk of inter-planetary communication, that is, communicating with other worlds, we mean by that two things: either communication of intelligence by some sort of signal system—be it radio, light, or other means; or otherwise communication in person by direct visitation, which pre-supposes a machine that can negotiate the void between the various worlds.

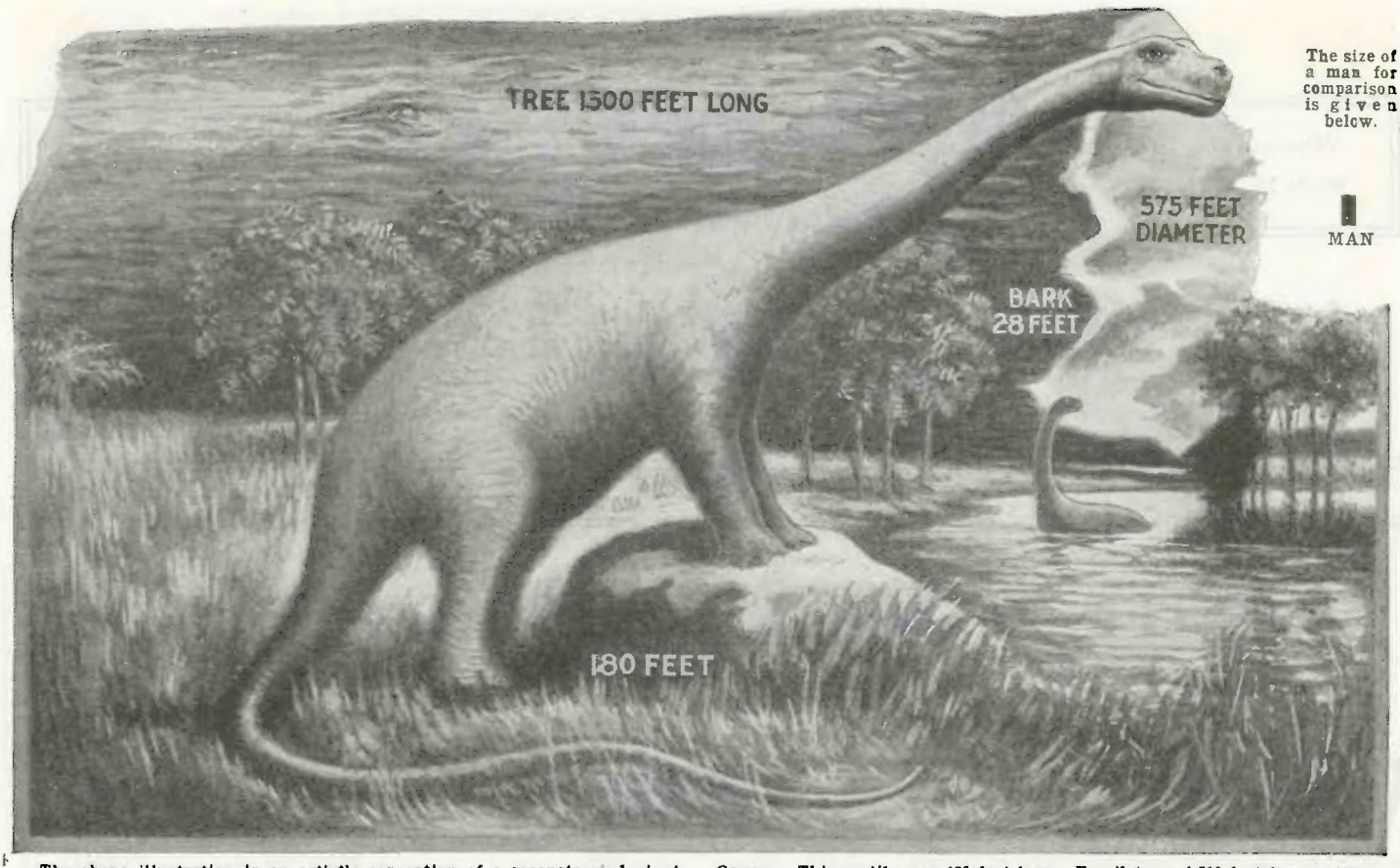
Taking the last basis, that is, transporting our own bodies through inter-stellar space, there is much doubt if such travel will ever come about, at least not for thousands of years. At the present time, the obstacles seem to be quite unsurmountable. In the first place, if we suppose that there exists, on other planets such as Mars and Venus, an intelligence infinitely greater than our own; and this seems only reasonable, particularly in the case of Mars, which is a world millions of years more advanced than our own, the following logic immediately comes to mind. If inter-planetary travel is possible—and there is an intelligence far exceeding our own, why then have we not been visited by these supposed inhabitants of the other world long ere this? If there really is such an intelligence, then the only other conclusion is that inter-planetary travel seems hopeless. To begin with—scientifiction writers notwithstanding—the problem of negotiating space is a tremendously fearful one. In the first place, the space flying machine, whatever its construction, will be exposed to intense inter-stellar cold, which is the absolute zero. While it might be possible to artificially heat the vessel, still we know nothing about the conditions that such a vessel might be subjected to in such an extreme cold. We do not know whether the propulsive means could operate in a vacuum in inter-stellar space and in an absolute zero at the same time.

But the greatest dangers to inter-stellar flying are meteorites, which abound in space, and it would seem quite impossible to dodge these missiles as they come flying through space with a speed that makes a cannon ball appear slow by comparison. Small iron meteorites, weighing ten pounds, are very common, and they move in space at the tremendous speeds of 2¼ to 38 miles per second. Due to their tremendous impact, they would wreck the strongest armor of the space flyer. There seems to be no way to prevent such meteorites from hitting the space flyer. It would seem that electrical apparatus which are supposed to detect such meteorites, as often mentioned by our scientifiction writers, could by no stretch of imagination be efficacious enough to ward off the disaster. This may be an over-pessimistic view, but it would not appear so in the present state of science. Then, too, another danger of which we know as yet very little, is the Millikan Cosmic Rays, which seem to be far more penetrating than the most powerful X-Rays. What these rays could do in inter-stellar space, with no protective atmosphere around the space flyer, no one can foretell. If these rays readily pierce through a dozen feet of lead with great facility, there would appear to be no way to ward them off inside of the space flyer, and what havoc they might raise with the travelers it is impossible to foretell at this time.

The other mode of communication of messages or words is either by visual light rays or radio waves, the latter being perhaps the more plausible method. It is known that short radio waves easily pierce the so-called Heaviside Layer. It would seem, therefore, that radio communication with a planet such as Mars or Venus is not out of the question, *providing* there are intelligent beings on these other worlds. The old question as to how to effect communication begins to shape itself more and more in the present light of knowledge. Heretofore it was contended that communication by dots and dashes, for instance, would be quite impossible, because you could dot and dash until doomsday, with neither the Earth or Mars being able to decipher the messages. In such a system there would be no "contact," because inhabitants of the two planets would have no basis of understanding each other in the Morse code. But with Television, if brought to a high enough degree, all this seems to be easy to change. The Martians, at their supposed high plane of scientific development, of course will have had Television for possibly millions of years. If in time we can intercept their signals and throw them on a Television screen, it will then be easy—provided we can answer—to establish communication. For instance, we would flash on our screen a picture of the earth globe, and then next to it there would be the word EARTH; then we would show the earth with the moon, with the word MOON near our satellite. Mars would most likely do likewise in whatever their symbols of expression would be, and then all could easily be studied by anyone well versed in the deciphering of languages and codes. In such a way we would have a *visual* way of communication, and it would not take very long to evolve from this a real system of communication, inter-change of ideas, news, literature and all other forms of intelligent development.

Of course, all of this lies far in the future, but as a mere theory it pays to speculate even on the impossible, because yesterday's impossible is tomorrow's reality and next week's commonplace.

**Mr. Hugo Gernsback speaks every Tuesday at 9.30 P. M. from Stations WRNY (326 meters) and 2XAL (30.90 meters) on various scientific subjects**




**The above illustration is an artist's conception of a reconstructed giant lizard, which Dr. F. B. Daude found in fossil form in Harney County, Oregon. This reptile was 180 feet long. Fossil trees 1,500 feet long, with a bark 28 feet thick, were also unearthed.**

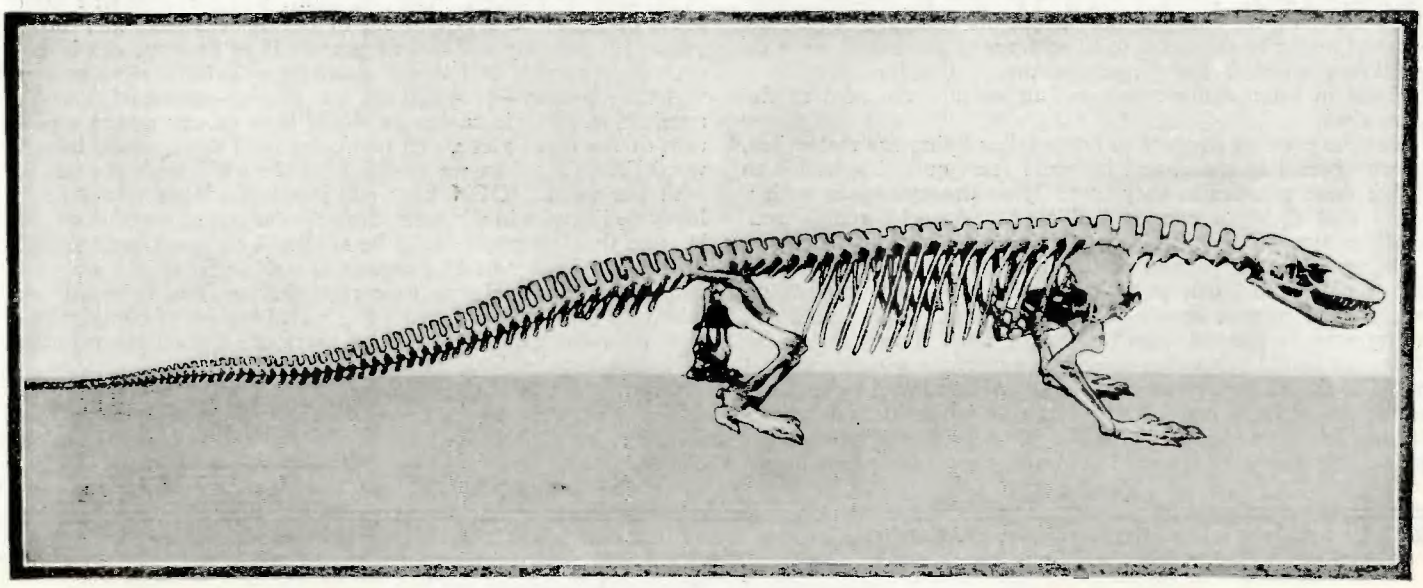
# Giant Lizards of Today and Yesterday

By JOSEPH H. KRAUS

AN announcement has recently been made by Dr. F. B. Daude, of Boise, Idaho, a noted geologist, of the discovery of reptilian fossils of immense size. This discovery is an important step in the tracing of the development of animal life, and so was the expedition to the Dutch East Indies and in particular, to the Island of Komodo, by W. Douglas Burden and his party. In his book on the Dragon Lizards of Komodo, Mr. Burden describes these carnivorous lizards. They are the oldest lizards dating as a genus to the beginning of the mammalian age. These lizards are substantially the same as those which roamed the face of this earth nearly sixty million years ago. They are not the largest lizards in this genus. Mr. Burden reports that there was one still larger which lived in Northern Australia during the stone age of men. This beast was over 30 feet long and weighed over 3,000 pounds. The Burden Expedition frequently came across a lizard more than 9 feet long. The skeleton of one of these measuring 9 feet 2 inches appears on this page.

Why these lizards still exist on the Island of Komodo is today still a puzzle to scientists.

The Komodo lizard is carnivorous in habit and it is particularly attracted to carrion flesh. Wild boar or deer was used to bait the traps set by the Burden Expedition. These traps were in the form of a box, one end of which was left open. They were made of trees laced together with bamboo. The trap was then camouflaged with leaves and a noose set in the opening after the trap had been baited. The rope of the noose



**The above photograph is a skeleton of a dragon lizard of Komodo (*Varanus Komodoensis.*). The sharp, recurving teeth enable this reptile to tear its food to pieces, which it swallows in huge lumps.—*Photo courtesy American Museum of Natural History.***

**Group of dragon lizards (each about 9 ft. long) as set up in the American Museum of Natural History. The female is feeding on a wild boar she is tearing to pieces. A full-grown male stands beside her. Another male at the left advances upon them from the jungle.**

was fastened to a pole or a tree bent over so as to serve as a spring. Two types of traps for catching this lizard alive were employed, the one which can be tripped by the lizard himself and the other which is released by hand.

It is a peculiar fact that the smaller dragon lizards will always run away from a source of food supply as a larger one approaches. Watching several of the smaller ones scurrying from the scene always indicated to the observers that a real big lizard was coming. When this lizard finally set his teeth into the bait, the trap was sprung and the lizard would be hurtled into the air at the end of a noose. He was then lassoed and placed in a cage. The Komodo lizards are quite deaf, but they have extraordinarily keen eye sight. They flash their long yellow bifurcated tongue in front of them as they move about.

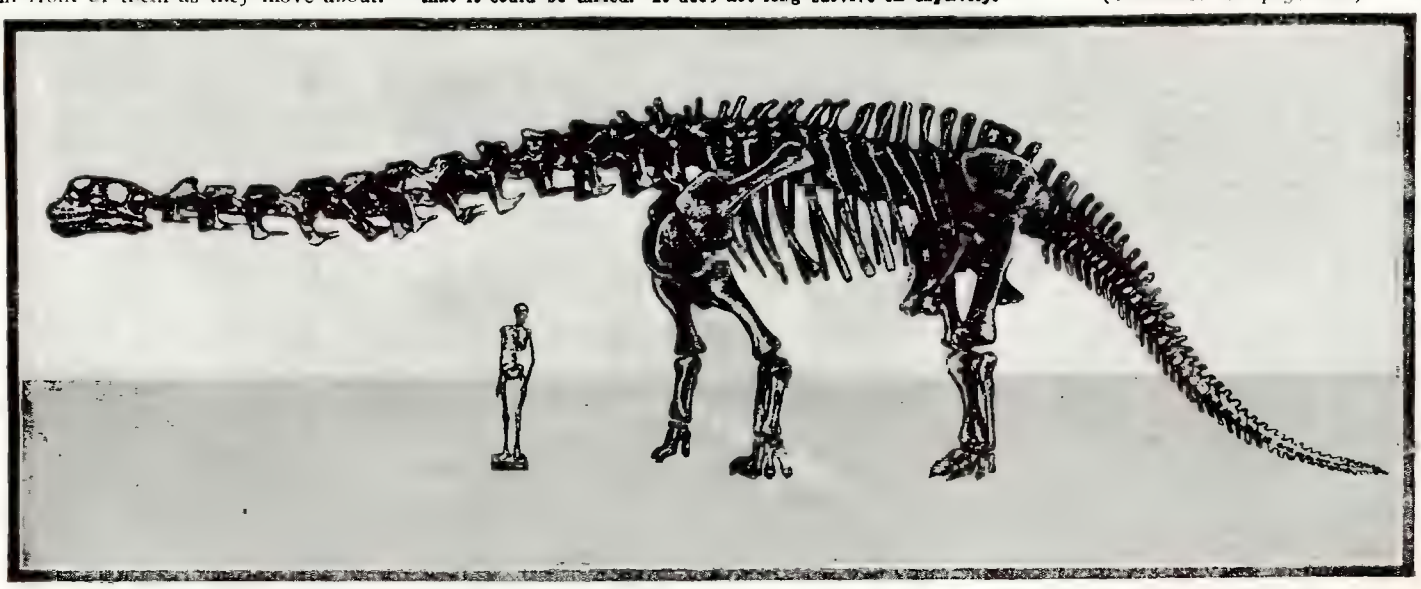
**Here is a real live dragon as it appeared at the London Zoo, a small Komodo lizard which has been tamed and trained to take eggs from its keeper's hand. One would never believe that it could be tamed. It does not long survive in captivity.**

While gorging themselves, the lizards use their long, sharp claws to scrape and tear the food, and with their teeth they rip off great chunks of foul meat. Mr. Burden records that on one occasion a lizard swallowed the whole hind quarters of a boar at one gulp, the hoofs, legs, hams, vertebra, and in fact, everything that goes to make up the hind quarters.

The Komodo lizards are easily excited and when so excited, they immediately disgorge themselves. If trapped they also lash their tails about ferociously. They are able to swim and can remain beneath the water for an observed period of 2 minutes.

The Burden Expedition did not see a lizard attack a live animal, although on one occasion one of them was seen to start making for a full-grown boar which ran away into the wood. While game is exceedingly plentiful on the

(*Continued on page* 137)



**Here is a mounted Brontosaurus skeleton in the American Museum of Natural History, measuring 66 feet long and 16 feet high. Beside it, we find a human skeleton. Yet for its massive height and size, the Brontosaurus had but little intelligence. The dragon lizards are survivals from such prehistoric monsters.**

# WHY BIG

## The Opinions of Several Eminent Hydraulic Engineers as to the Probable Cause of the

H. WINFIELD

Photo above shows St. Francis Dam before it broke.

With a thunderous roar which terrified those who heard it, the St. Francis Dam in California "let go" unexpectedly, and the twelve billion gallons of water stored up behind it swept down the Santa Clara River Valley.

WITH a terrific booming sound that seemed to herald the coming of Judgment Day and the end of the world, twelve billion gallons of water stored up behind a huge concrete dam burst through it and went roaring down through the Santa Clara River Valley in California recently, spreading death and destruction as it went. It is considered probable that four hundred people lost their lives when the huge concrete dam, known as the St. Francis Dam, collapsed and liberated this huge quantity of stored up water, and just where the blame for this terrible catastrophe should be placed is a question which may never be answered satisfactorily. The accompanying pictures show some of the reasons why big dams, and of course little ones too, sometimes burst or collapse through improper engineering design or weak foundation materials under the dam or at the sides where the dam is anchored.

Mr. Edward Hyatt, Jr., State Engineer of California, after he had inspected the wreckage of the dam, refused to give any definite opinion as to whether the collapse was due to engineering mistakes or to natural causes over which man has no control, according to public press accounts. He ventured the opinion that the collapse of this huge concrete dam was probably caused by foundation weakness in the abutments of the dam. He stated further that the abutments of the dam were anchored in a red conglomerate rock, which was found to be very soft; but whether it was soft in its original state or had become so through action of the rushing water, he was unprepared to state. Mr. Hyatt is quoted further as having said: "that there was no question in his mind, that had the dam had a sufficiently strong foundation, the tragedy would never have happened." It was his opinion further "that in view of the fact that the center of the dam still remains upright," as the photographs herewith show, "that the good quality of the cement used was proven." The writer has found that

St. Francis Dam, after it had burst; note that the center portion still stands in place. Huge size of dam may be judged by noting man in white circle. Dotted line shows original dam contour.

# DAMS BURST

## Collapse of the St. Francis Dam Recently in California is Herein Set Forth as Told to

## SECOR

among several engineers with whom he talked, in regard to the St. Francis Dam disaster, that one of the great scientific mysteries concerning the whole affair is, that it is hard to work out even a theory as to why both wings or sides of the dam should have given way, apparently within a few seconds of each other.

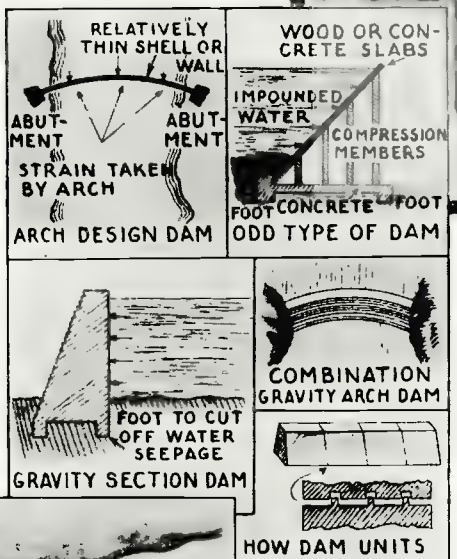
One of the prominent hydraulic engineers, whom the writer interviewed, a man of many years experience in building large concrete and other forms of dams, in this and other countries, stated that this was one of the greatest enigmas in the collapse of a big dam, such as the St. Francis, that he had come across in all his experience in dam construction and operation.

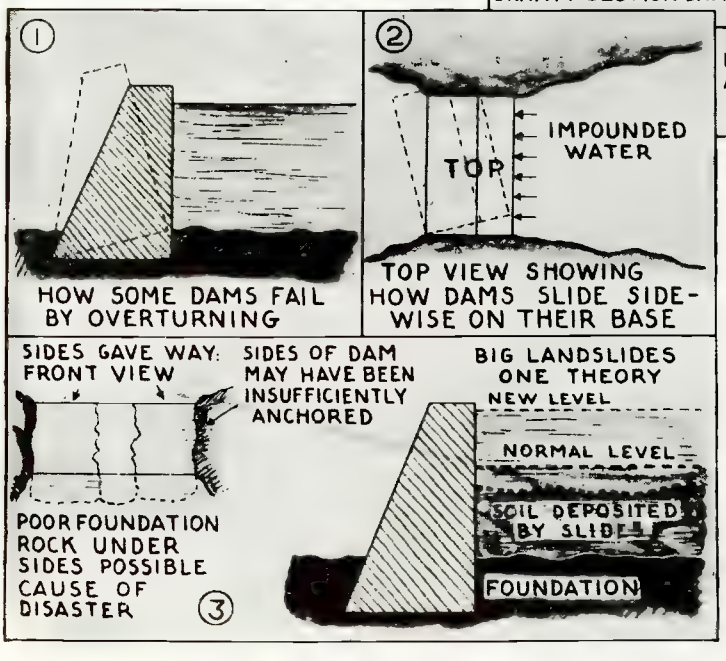
The engineer who built the St. Francis dam, Mr. William Mulholland, veteran chief engineer of the Department of Water and Power of Los Angeles, stated (according to the *New York Herald-Tribune*) in his recent testimony before a coroner's jury at Los Angeles, that he fully believed the St. Francis Dam to be safe, or else he would never have ordered a drop of water to be put in the storage reservoir behind it. Mr. Mulholland stated that after the dam was completed with the usual careful inspection from day to day, tests were made by means of core drillings. Mr. Mulholland recited in his testimony that he had visited the St. Francis Dam eleven hours before its collapse, and that leak conditions were very bad. Muddy waters observed in the reservoir indicated an earth leak, which is always more or less of a serious matter to engineers, press reports quote him as saying.

One of the eminent hydraulic engineers interviewed by the writer in New York City, a gentleman who knows Mr. Mulholland, gave as his opinion however, that there are always invariably some earth leaks around large dams, and that the observance of muddy waters in the reservoir or below the dam did not at all necessarily indicate that the dam might suddenly fail or burst. The chief engineer, Mr. Mulholland, had visited the dam at the call of the keeper, Tony Harshelfeger; the keeper had seen new leaks through the earth and sent for his chief. Tony Harshelfeger was one of those who died when the dam broke.

**The gigantic size of the solid concrete St. Francis Dam in California, which recently gave way and liberated twelve billion gallons of water, can be judged from the photograph at the right and noting the comparative size of the man standing on one of the broken concrete fragments. The man is visible at the extreme left of the picture. Several different types of dams are shown in the center drawing below. In the arch type dam the wall is usually about two feet thick.** →

**The St. Francis Dam was of the gravity-arch type illustrated. An odd type of dam is the wedge shape design illustrated. The method of dividing large concrete dams into several sections to allow for expansion, is illustrated.** ↓




**At the right of Fig. 3 above, we see how major landslides may have caused water level behind the St. Francis Dam to rise, the large deposit of silt, by its weight, increasing the total pressure on the dam. The landslide theory was advanced early by a prominent engineer familiar with the St. Francis Dam. Engineers who inspected the site of the broken dam are said to have found evidence of such landslides.**

← **Engineers in general do not care to express any positive opinion as to why the St. Francis Dam collapsed. The pictures at the left show, at 1 and 2, how dams frequently fail in their purpose. As shown at 1, gravity dams not sufficiently heavy, may turn over, either forward, or else their base may be thrown forward and up; or again they may be skidded sidewise on one corner or another, by the water pressure, as shown at 2. One expert believes that the foundation rock under the St. Francis Dam disintegrated, the side rock giving way for the same reason.**

### NATURE OF BASE IMPORTANT

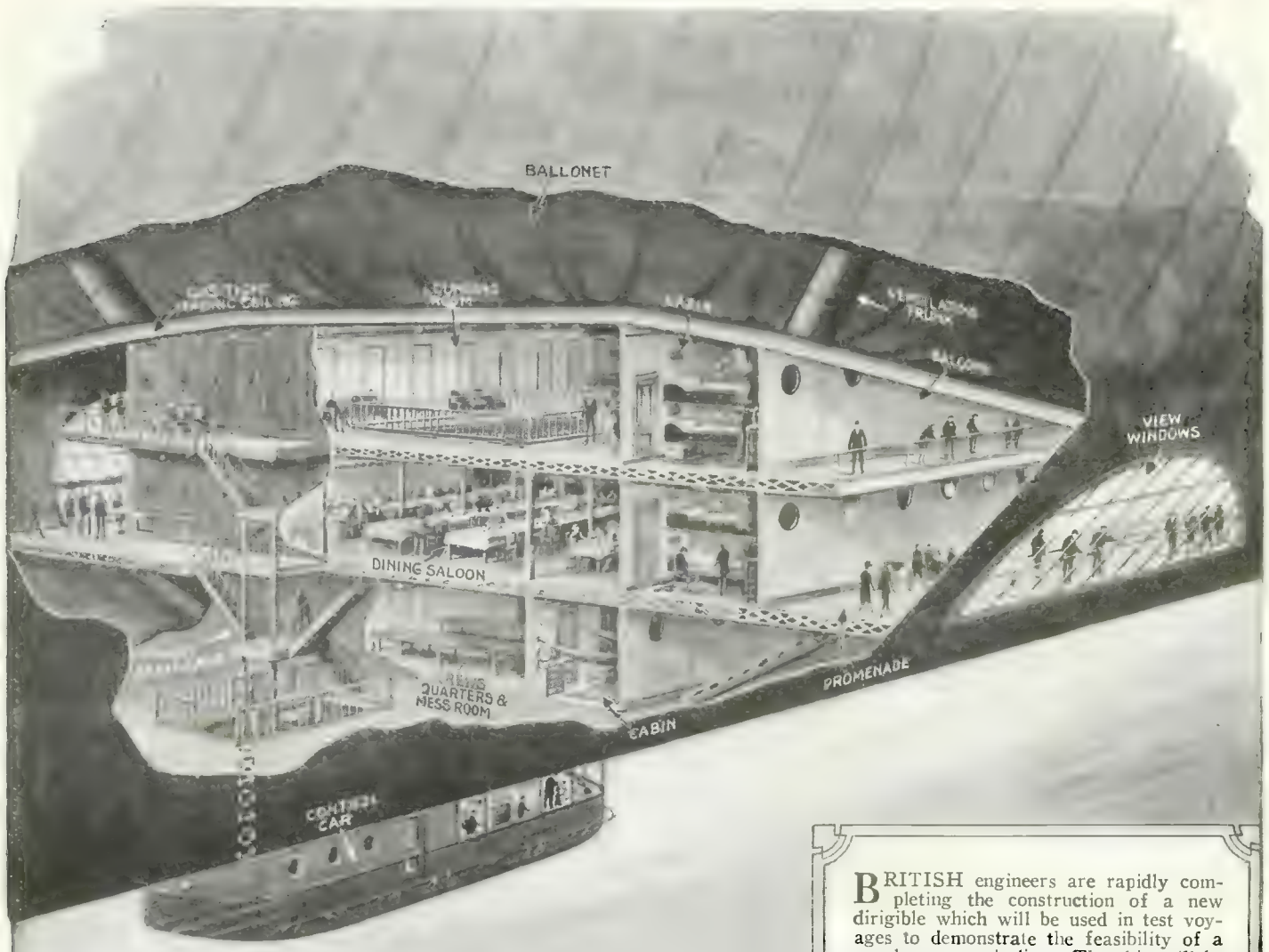
IN some of the testimony regarding the failure of the St. Francis Dam, it was stated that the dam was based on red rock twenty feet below the natural surface of the ground. There are various kinds of red rock, some of which is very soft, and which becomes rapidly honeycombed when placed in contact with water; on the other hand, there are forms of red rock, such as red granite and sandstone, which remains hard and firm in the presence of water. Mr. Charles Petit, County Engineer of Ventura County, California, is quoted in press dispatches as having criticized the foundation rock on which the sides of the great St. Francis Dam were built. Mr. Petit stated that the rock on which the concrete sides of the dam were anchored is composed of decomposed or altered granite, which geologists probably would describe, he said, as mica schist. This engineer stated further that when such strata is subjected to water pressure, it crumbles, and he seemed to think that undoubtedly this is what caused the St. Francis Dam to break, the decomposed rock at the sides, weakened by the water, gave way and then the structure went. Mr. Petit is said to have stated further—that a dam should never have been constructed at this point in the St. Francisquito Canyon, because of the fact that the rock in this section all seems to be largely of the same character.

It was the opinion of one of the hydraulic engineers whom the writer questioned as to the collapse of the St. Francis Dam, that

(*Continued on page* 162)

# A Trans-Oceanic Dirigible

## Huge English Ship Accommodating 100 Passengers Nearing Completion

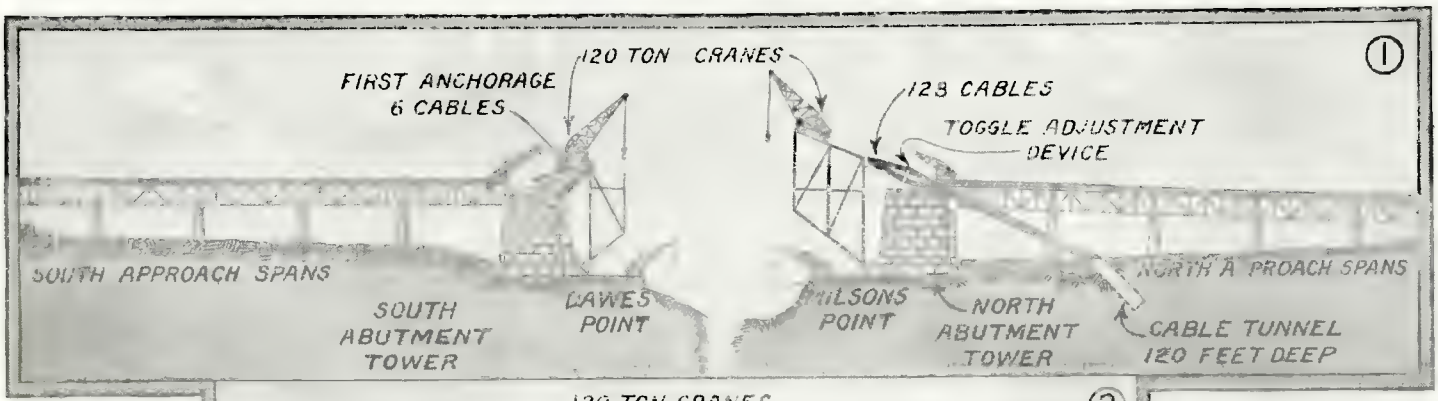


BRITISH engineers are rapidly completing the construction of a new dirigible which will be used in test voyages to demonstrate the feasibility of a regular ocean air line. The ship will be used on a New York, London, Montreal route. The passenger accommodations consist of the equivalent of a three-story house. The crew's quarters are situated on the lower floor, and above this are two promenade decks and a restaurant which will seat fifty persons at one time. The cabins are all equipped with either two or four berths and are fitted with electric light and compartments for baggage. A smoking lounge and two balconies are situated on the top deck. All the heating, lighting and cooking will be done by electricity. In the dirigible there are no engine noises and no vibration or any motion equivalent to that of an ocean liner. It is believed, therefore, that there will be no air sickness amongst the passengers. The R-100 is 709 feet long, and 133 feet wide. In making the outer envelope, 225,000 sq. ft. of fabric was used. This envelope is non-inflammable, thereby eliminating one of the greatest dangers attached to dirigibles. One of the interesting features of this "flying hotel" is the fact that when fully loaded with passengers, crew and supplies, the "pay load" is about 20 tons. Special fuel tanks capable of carrying 50 tons of fuel are being built into the ship. A larger trans-Atlantic vessel than the R-100 is now being planned.

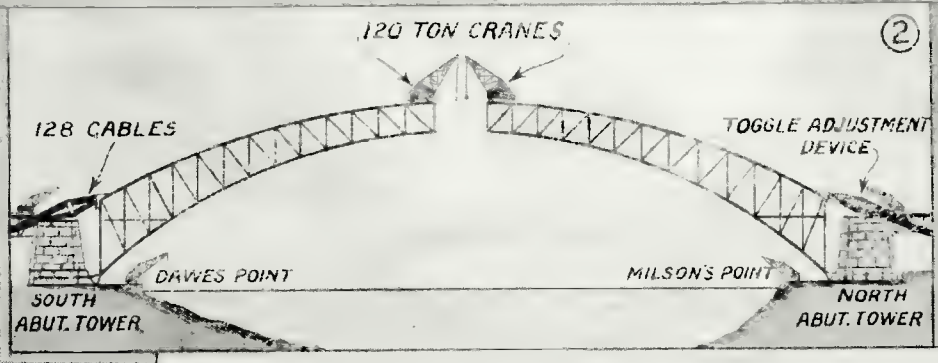
# How a Single Span Bridge Is Built

By FREDERICK C. JONES

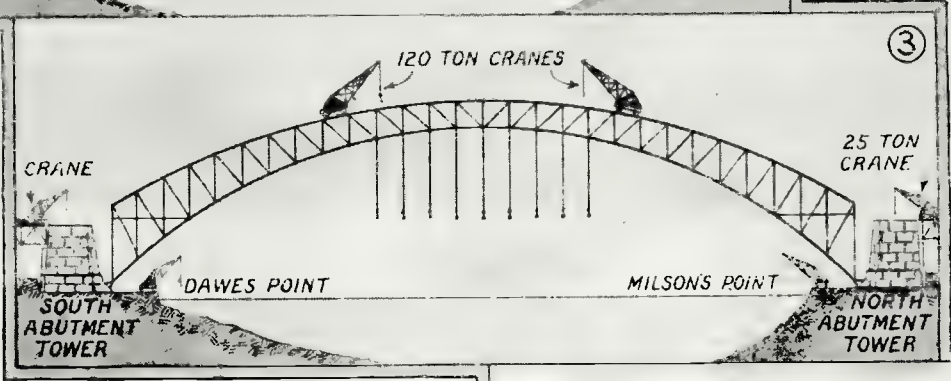
## Construction Method Used in Building a Huge Arch Across Sydney Harbor, Australia




The illustration appearing above shows the first stage in the construction of the single span bridge. Both sides of the harbor, with approaches and abutment towers, are shown. The creeper cranes weigh 570 tons each and will lift 120 tons. The anchorage cables are only temporary.
*Illus. courtesy of Sydney Mail.*

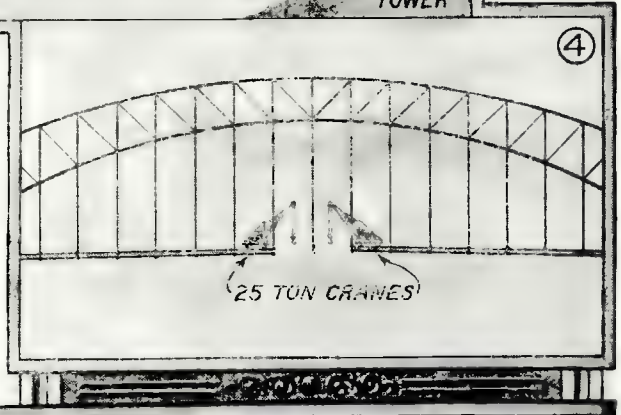


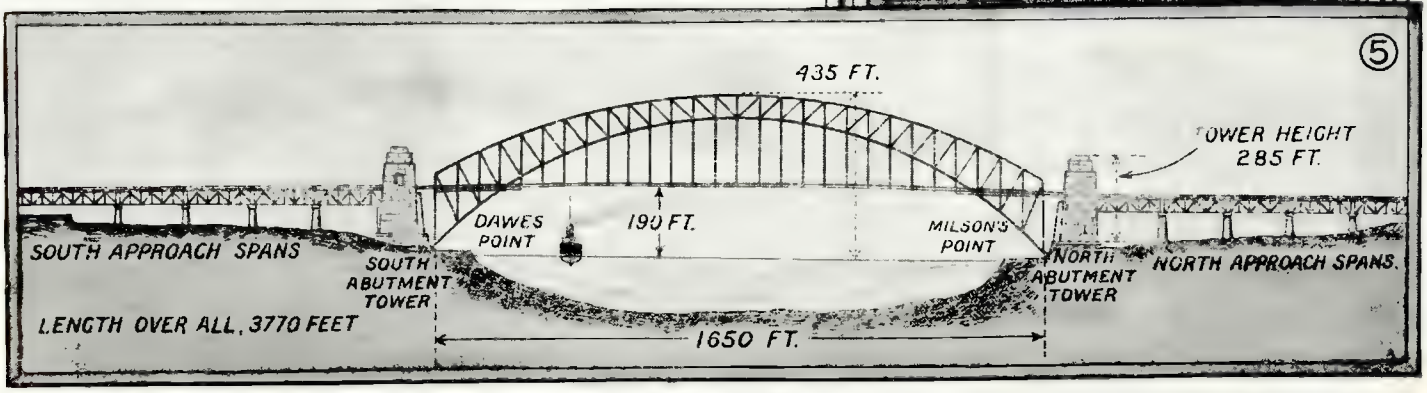

The second stage in the construction is shown at the left. The cranes have put in place panel after panel, until the span is meeting in the middle. The half arches can be adjusted as the bridge progresses by means of a nut and bolt device on the supporting cables, which may be tightened or loosened, lowering or raising the arch.



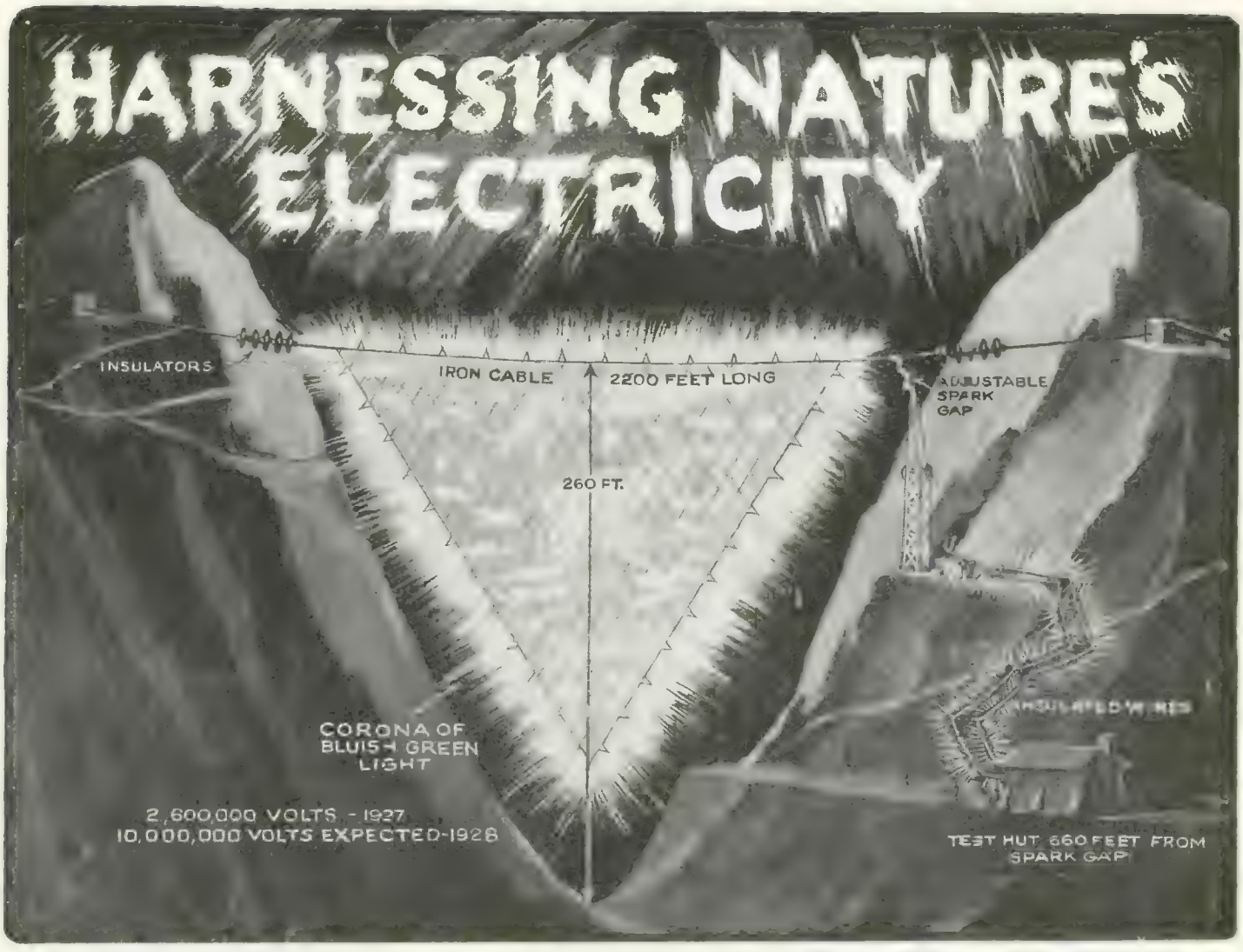

The third stage in the construction is shown at the left. After completion and final riveting, the creeper cranes start to work backwards, making way for the riveting gang.

THE problem of building a bridge to span Sydney Harbor, in Australia, has been debated pro and con for many years. At last it was decided to bridge the harbor by means of a single arch span bridge, and the construction was entrusted to a well-known English concern. The builders have erected huge workshops covering several acres and have built one of the largest testing apparatus for determining strains. The overall length of the bridge is to be 3,770 feet and the length of the main arch span will be 1,650 feet. The roadway will be approximately 190 feet above sea level and the highest point of the steel work, 435 feet. The towers will be 285 feet high. The step-by-step construction of this bridge is shown in the illustrations appearing here. The construction will start simultaneously from either side of the harbor, as shown in the first illustration. When the two arches are about to meet in the middle, the cables will be tightened or loosened, so that they will meet exactly. The riveting will be done by hydraulic jacks. After these spans have been connected, the two 120-ton cranes will work back to their starting position and the work will be carried out from thereon with 25-ton cranes. These cranes will assist in the erection of the deck structure, which carries the road and railways, which are suspended by huge hanging cables from the main span. These roadways will be started from either end and will meet in the middle. The completed bridge will take 60,000 gallons of paint.



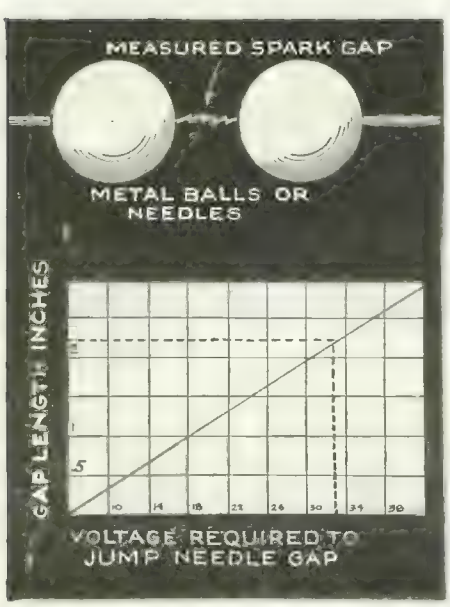




The fourth stage in the construction is shown and consists in building the road and railways. The completed bridge is shown directly above.




**The above scene shows the remarkable electrical effect which frequently occurs in the Alps Mountains, where three young German scientists are endeavoring to extract tremendous electrical discharges from the atmosphere. The idea behind these experiments is that man may find a way to disintegrate the atom, and thus unlock a tremendous new source of energy.**

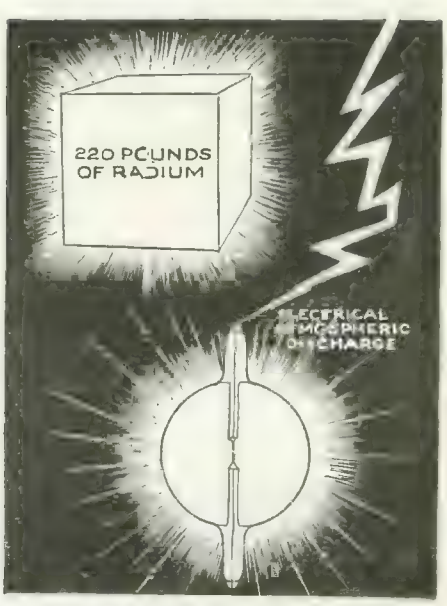
BENJAMIN FRANKLIN, fired the imagination of electrical engineers and experimenters all over the world for a century beyond his time, when on an immortal day he demonstrated by means of his kite, that lightning was a natural electrical phenomenon. Every student of electrical matters has at some time or other dreamed of utilizing the gigantic electrical charges which are ever present in the atmosphere surrounding our earth. Several scientists have lost their lives while trying to harness the tremendous electrical discharges in the form of lightning. Last summer and again this summer, three young German scientists, A. Brasch, F. Lange and C. Urban of the University of Berlin, aided by all the latest scientific information as to how to protect themselves, will attempt to measure and chart the atmospheric electrical discharges high up in the Alps.




**Sphere spark gaps, and in some cases needle gaps, of predetermined dimensions are used for measuring high potential discharges. When a discharge jumps a certain length of gap, the voltage is easily read from the calibration chart.**

These daring young scientists found in last summer's experiments that electrical sparks of great intensity and accompanied with a roar like that of huge cannon, jumped the gap of their apparatus repeatedly, even when no electrical storms were in the vicinity. On several occasions electrical sparks jumped the large gap on an average of one every second for thirty minutes, and these discharges averaged two million volts. A beautiful corona of bluish-green color played around the cable and wire net at night. The cable and net were suspended across the valley between two peaks in the Alps, as the accompanying pictures show. This corona had all the appearances of the Aurora Borealis, that most magnificent electrical display observable in the arctic regions particularly.

In last year's experiments, the three scientists measured atmospheric discharges having potentials as high as 2,600,000 volts, when the summer electrical storms were practically over; it is hoped this year with the improved apparatus to measure potentials up to ten or more million volts. It is known that potentials of from 5,000,000 up to 30,000,000 volts passes to earth from an




**It is hoped by the European investigators that a sufficiently powerful atmospheric electrical discharge can be obtained, which will yield a power equal to the Alpha rays obtained from 220 pounds of radium.**

# Remarkable European Experiments with Atmospheric Electrical Discharges with Potentials as High as 3,000,000 Volts

## By HENRY TOWNSEND

elevation of 350 ft., and these students of natural electrical phenomena have found a very desirable location in the Alps, where they can suspend between one mountain and an adjacent one, a strong iron cable having a length of about 2,000 ft. This cable is about 250 feet above the intervening valley, and from it these daring engineers have suspended a coarsely woven wire net, which serves as an electrical capacity to gather the electricity from the atmosphere. As shown in the pictures, the wire net is supplied with numerous sharp points to aid in collecting the current from the air.

As the accompanying photographs of the actual apparatus and wire cable used last year clearly show, an adjustable spark gap of considerable length is provided. By adjusting this spark gap to various lengths, it is possible to judge the voltage of the discharge which leaps the gap at any moment. Mr. F. W. Peek, Jr., the well-known American worker in the realm of high voltage measurements, together with other engineers, have provided tabulated data and curves for various lengths of both needle and sphere type spark gaps. As one of the accompanying diagrams shows, it is a simple matter to calculate the voltage when a certain length of gap is used. The engineer first checks the length of the gap on the chart; he then follows a line horizontally from the gap length, to where it intersects with the angular line on the chart; and from the point of intersection he looks in a visual line downward to a place where the voltage is given. For needle spark gap measurements, the characteristic curve on the chart is practically a straight line, while for sphere gaps the characteristic curve on the voltage versus gap length, is a curved line. Those interested in high voltage measurements by means of the spark gap method can find the voltage-gap tables and charts in the *Standardization Rules* of the American Institute of Electrical Engineers. According to Mr. Peek's researches, the voltage per foot of atmospheric electrical discharges is about 100,000, while in laboratory measurements with A.C., transformer high potential discharges, the average voltage per foot of spark was found to be about 150,000 volts. The voltage of a lightning flash may

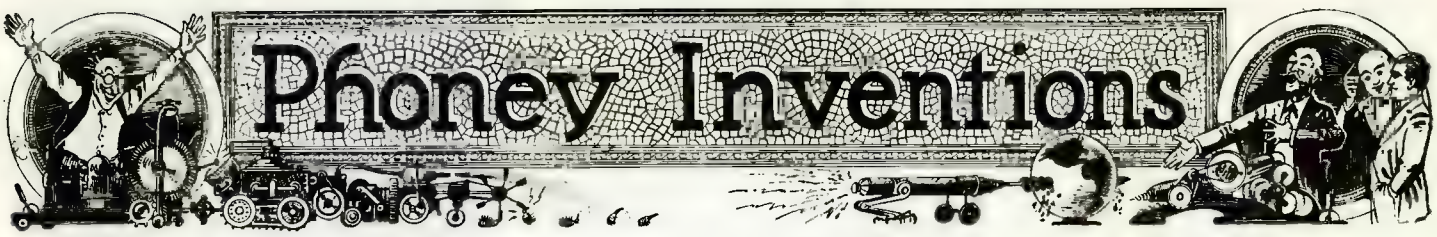
(*Continued on page* 156)

Actual photo above shows 13 ft., heavy spark obtained from the collecting net in the Alps by the German scientists. The voltage is about 2,000,000. The spark occurred once per second for 30 minutes.

Photo, left, shows the adjustable spark gap used in the Alps. Notice the heavy electrode on the end of the adjustable arm to which the spark jumps.

**Actual photograph of the experimental "kite" used by the German experimenters in the Alps Mountains, for the purpose of accumulating high potential electrical discharges from the atmosphere. Note the size of the insulators.**

Below we see 3,000,000-volt artificial lightning stroke produced in G. E. Laboratory at Pittsfield, Mass. Note man.

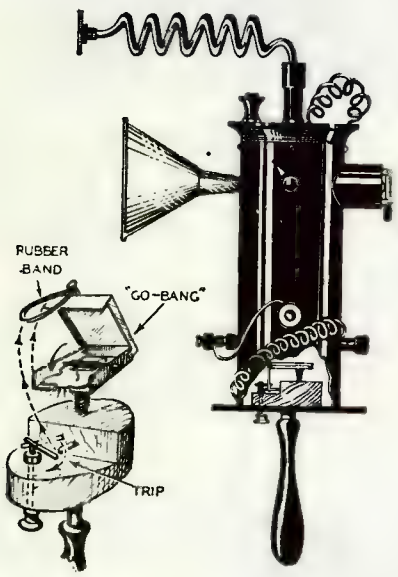



## A Brand New Means for Entertaining

By HUGO GERNSBACK

*Member American Physical Society*

PEOPLE nowadays wish to be entertained more than at any time before. Conversely, the man who knows how to entertain is in constant demand and enjoys a popularity all his own. Not everybody can be an accomplished musician, not everybody can be a magician, not everybody can be a good story teller, and many of us who have other qualities frequently have to sit back and let the laurels go to others.




**The above diagram indicates the details of the halitosis detector. The most important feature here is the "go-bang," a small metallic box provided with a trigger-like arrangement which sets off a cap when the device is released. A rubber band holds it closed until such time as the operator turns the knob connected with the trip which releases the rubber band from its catch. All other apparatus is incidental.**

In the new form of entertainment which I present herewith, practically everyone who can do a little talking and who is mechanically inclined can become a star entertainer, one who will always be in demand, one who will always be able to entertain at any function and to regale and amuse his friends.

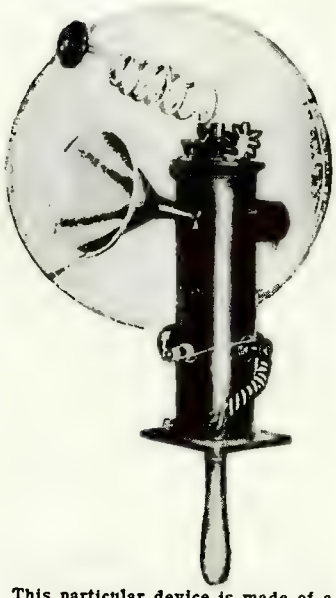
For want of a better term, I am calling this form of entertainment "Phoney Inventions." The underlying idea of this form of entertainment is simple. In a few words, it means to get up some unusual mechanical contraption in which the surprise and humor element are such that when demonstrated will not only be entertaining, but cause a good deal of amusement.

I have tried a number of these stunts with excellent success and actually made all the apparatus shown here simply as a guide to those who wish to produce entertainment along these lines.

The way the entertainment is best staged is as follows: a simple disguise is obtained, usually a huge beard, and an old battered silk hat or some other comic raiment. The underlying idea of this makeup is that you are supposed to be some crack-brained inventor. Take on such a name, as for instance, "The Famous Broffessor Hasenpiefer" or some other similar mirth-provoking name.

**WE are starting a new Department in this issue which will be known as *"Phoney Inventions."* This is a brand new means for entertaining your friends. It is exceedingly useful for home parties and club gatherings. Anyone handy with tools can make a Phoney Invention. The principle of this new entertainment is to have a ridiculous device that gives unexpected results or that is otherwise mirth-provoking. Anyone can make one of these contraptions in his spare time.**

**SCIENCE and INVENTION will pay $5.00 for every Phoney Invention submitted to this department and accepted for publication. Full description of the invention, with drawings and photographs accompanying the same will be published in this Department. If photographs cannot be supplied, the device may be sent to the Editors for their inspection, after which it will be returned to the maker. Address all correspondence to Editor, Phoney Inventions.**



**This particular device is made of a metallic tube, approximately 12 inches long. A funnel is soldered to the can and projecting from the top is a coiled aluminum tube, attached to a metal disk. There is a rheostat in one side and a switch at the back, purely for impression. The cap is exploded by action of the thumb or finger.**

**Miss Bess Shapiro and Mr. J. H. McMahon demonstrating the halitosis detector.**

**Statistics show that pyorrhea catches four out of five, but halitosis gets ten out of nine. Someone should tell these ten people that they have halitosis, but "only a child will tell." Hence, the inventor has entered upon mental calisthenics and as a result, we have the halitosis detector indicated above.**

It is a good idea to get a satchel in which to put the various inventions and then pull out one at a time for demonstration. Before each invention is sprung, it is necessary to first indulge in some talk or patter, on the subject of inventions. You may call to the attention of your audience that inventors have always been downtrodden, but that they are responsible for great things, and that you are now ready to present to the public some of the greatest inventions that have ever been made. To give an instance how this can be worked, I give a typical example.

"Ladies and Gentlemen and all others: Certain inventions which have been most assuredly some of the greatest inventions of our age, are those that do not appear so on the surface. I have here, for instance, a little invention which will prove of the most far-reaching results all over this planet. To show you what I mean, let me call to your attention that if you have a dirty face, your mirror, which was another important invention, will tell you so immediately, or if you have a red nose, your mirror will tell you that also and you can rectify it in many ways. But as for halitosis, here, Ladies and Gentlemen, is the one thing most personal to you that no one will tell you about, not even your closest friend. There is no mirror which will tell you anything about halitosis. Yes, my friends, I have here a little invention which I call the "Halitosis Detector." All you have to do is to breath into this, and immediately the top aerial will start

**The phoney invention cigar lighter in use. This is being demonstrated by Mr. F. H. Canfield and B. Weinstein. It never fails—to both light and produce mirth.**

revolving, which shows you that you actually have halitosis. When the aerial does not revolve, all is well with you, and you can go and kiss your best girl. Now, Ladies and Gentlemen, I shall demonstrate to you this marvelous invention, this great and remarkable halitosis detector. Will anyone in the audience see if he or she has halitosis?"

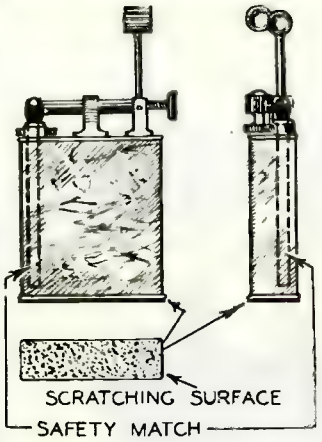
The instrument is then produced, which may be seen illustrated on these pages.

As soon as the willing victim has been found on whom the joke can be played, you turn the little screw and the instrument goes off with a great BANG, making a noise like a small revolver. Everybody laughs, and at the top of the merriment, you shout, "He's got IT!"

In this Phoney Invention, the surprise element is the important part. No one knows what is going to happen, and the unexpected result is usually greeted with glee. Another important point, is, of course, that every contraption you make should even in itself look so ridiculous as to provoke mirth, or if that is not possible then the result must be such as to be mirth-provoking.

Any one handy with a few tools can get up any number of these Phoney Inventions, and the time taken to build them will be well repaid by the results obtained. The ones shown on these pages are a number of Phoney Inventions which I recently used at an entertainment function and each and every one produced a great deal of amusement.

I shall in a few words enumerate the purposes and uses of these Phoney Inventions and shall briefly describe the surprise reaction which results.



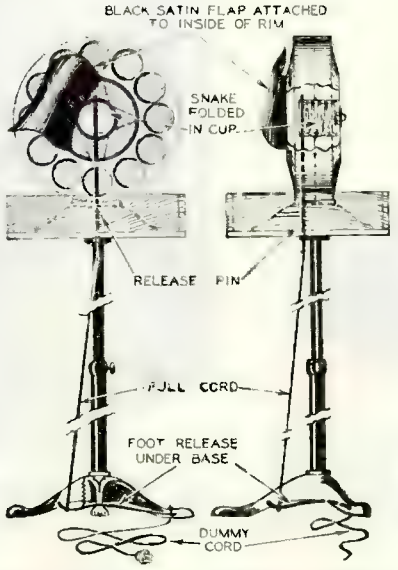
**Photograph on the right shows the phoney invention cigarette lighter and at the left are the details of its construction. Note that the wick has been removed and a safety match substituted therefor. A scratching surface is shellacked to the bottom of the box. This can be obtained from an ordinary match box.**

### HALITOSIS DETECTOR

THIS contraption was made with a few old parts lying around the laboratory and the illustration shows the simple way in which it was made. Of course, all the paraphernalia, such as switches, binding posts and aerial, mean nothing. They might just as well be replaced with anything equally foolish. The more ridiculous the device looks, the better. The secret lies in the so-called "go-bang." This takes an ordinary children's pistol cap, which is placed in such a way that when the rubber band is released the hammer hits the cap which goes off with a loud report. The noise is sufficient to scare the victim, but not bad enough to injure him or do harm.

One of the pictures shows an actual photograph of the device and another shows how it is used. I would advise not to try it on the ladies, but try it on one of your young men friends, who will enjoy it.

**Here we find a photograph of the microphone which detects sour notes. The aluminum cup is supported on the inside of a studio microphone case. The snake fits into the cup.**




**Here are the details of the "sour note" detecting microphone. It will be observed that there is the regular spring snake coiled up in a cup centrally located in a microphone case. A black satin flap covers the device. A pin holds the snake in the folded position, and this pin communicates, by means of a piece of wire, with a foot release, mounted beneath the microphone stand. A dummy cord plugs into a floor outlet to give the audience the impression that the microphone is actually connected to a distant broadcasting station.**

### MICROPHONE

THE second Phoney Invention is a fake broadcast microphone. This can either be made in its entirety or a shell can be bought from a broadcast station. The one illustrated is an obsolete model and most any broadcast station will be glad to either sell or loan you one of the dummy cases. If you have a party at home, announce to your friends that you are broadcasting some of the entertainment. To make this more realistic, if possible, a real announcer, who, of course, should be told all about the device, should be borrowed. If this is not possible, some one has to be a substitute announcer. A wire runs from the microphone to some lighting fixture to make the whole thing appear real, but of course there are no electrical connections whatsoever. The pictures and illustrations illustrate the device and give all the necessary data. When everything is set, all the audience must be cautioned to remain absolutely quiet, because Mr. or Miss So and So is to broadcast a song or recitation, or what not. Of course, the persons who are to sing into the microphone do not know that it is a fake and do not know they are the victims. After the

(*Continued on page* 159)

**Radio stations have great difficulty in selecting artists for broadcast programs. They also have extreme difficulty in telling these artists that their voices do not register well, hence they could not broadcast songs rendered by such persons. With a view toward eradicating this difficulty, the invention shown above has been developed. When a sour note is produced, "the artist knows it." Miss Vera Zirpolo and "Bill" Romaine demonstrating the "microphone sour note detector."**

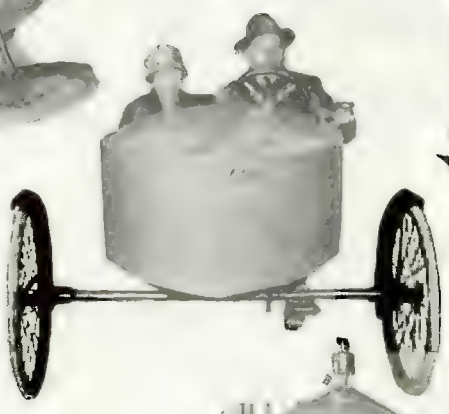
# Scientific

## A Photographic Picturization

It is almost impossible to keep up with the rapid strides taken in the field of science. This is truly a scientific age.

**Henry Fleur,** of San Francisco, recently demonstrated his model submarine which works entirely without propellers. The model which is shown above sucks in water through the bow and expels it under terrific pressure from the stern. The release of this water carries the craft forward and it makes 35 knots an hour below the surface and 55 knots an hour on the surface. According to the inventor, the model marks a new trend in marine navigation. The stabilizing fins on the propellerless submarine are being pointed out by Mr. Fleur.

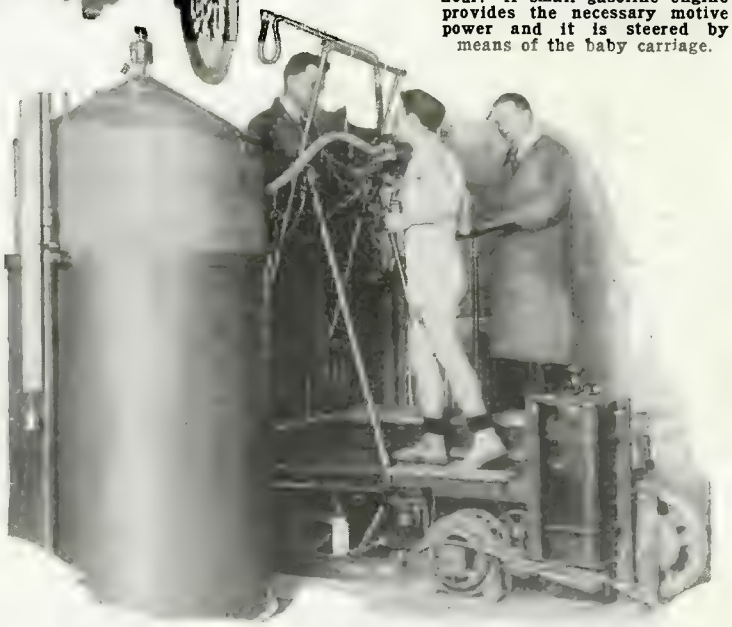
**A new novelty car has recently been patented in Paris, France, and will soon be the latest attraction on the streets for children. A front view of the "Velocar," as it is called, is shown in the photograph below.**



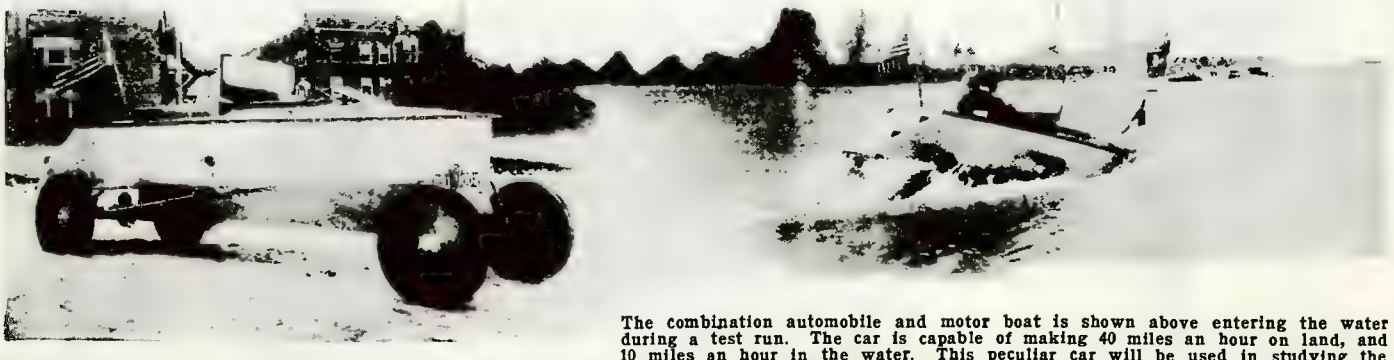
**Above is a bottom view of the car which is propelled by means of pedals arranged in pairs, so as to enable two persons to drive it at the same time. The car is equipped with a light metal body and four rubber-tired wheels, similar to those used on a bicycle. Charles Mouchette and his wife invented the novelty car and are shown seated in it, in the photo at the right.**

**England's latest invention for airing infants is shown above and is known as a "Pramobile." The new baby carriage is capable of moving with a speed of a mile and a half an hour. A small gasoline engine provides the necessary motive power and it is steered by means of the baby carriage.**

**An airplane motor which weighs but fifty pounds is shown above. With the exception of the ball bearings and adjusting screws, the motor has but four major parts and has no valves or springs. The single cylinder acts as a cam to separate the intake and exhaust. The inventor, Edwin L. Rice, claims that the motor is equivalent in horse power to a 450 pound motor. The motor is capable of making 200 miles per hour.**



**For use in air experiments on muscular fatigue and activity, Prof. Hendersin and Dr. Dill have devised a sort of treadmill to which a number of indicators are attached for measuring the amount of carbon dioxide given off during ordinary and strenuous exertion.**



**Above is a combination auto and motor boat which is to be used for volcano study in Alaska. The car-craft was built by George Powell, of Chicago, and will be used by the National Geographic Society's expedition.**

**The combination automobile and motor boat is shown above entering the water during a test run. The car is capable of making 40 miles an hour on land, and 10 miles an hour in the water. This peculiar car will be used in studying the action of volcanoes in Alaska. The nature of the itinerary is such, that the expedition will have much use of the combination auto and boat.**

# Progress

## of Modern Scientific Advances

On these pages we can portray but a few of the advances made in many different fields.

The photograph at the right shows Mrs. Geneva Maddock with a flowering rose bush in its garden, which in this case is a jar of chemically treated water.

It is expected that the new discovery recently announced by Dr. W. F. Gericke, plant physiologist at the University of California, will revolutionize the floral industry. Experiments have been conducted for several years with artificial plant cultivation. The only thing that is required to grow beautiful flowers is a jar of chemically treated water. It has been found that some plants react better to one chemical food than others, and the water is treated in accordance with the requirements of the plant. It will also be observed that the bottles of water are covered with wrapping paper so as to exclude as much as possible any sunlight from acting on the roots of the plant. Note the superb roses all grown in water.

Of course, you know the man in this picture. He is none other than Gar Wood, the noted speed boat builder in his own observation tower, sitting at a telescope with which he obtains a magnification of from 38 to 560 diameters. Photo taken in his Miami Beach home.

The photograph below was taken at Paris and it shows the French electrical engineer, Rene Bertrand, with a device which he has invented for producing musical sounds electrically. He claims that this instrument has more possibilities of range and power than other devices of a similar kind. He is being assisted in manipulating the note fingers by a colleague.

At the Birmingham Industries Fair a table tennis ball is being weighed by the spring scale held in the hand of a demonstrator. And along side of it we find another spring scale of different proportions. This will register weights up to 100 tons. The British Fair where products of various industries were exhibited attracted great crowds.

An architectural engineer of Hamburg, Germany, by the name of Willie Neiss, whittled 3000 hours away in the construction of this six foot model of New York.

The model above is 4 feet wide, 1 foot high and weighs 77 pounds.

New cabinets for the sterilization of dental and surgical instruments employ super-heated steam. The above is installed at the New York University College of Dentistry, and is demonstrated by Miss Kathryn Blond.

# Helicopters

## New Advances in the Field of Aeronautics Relate to

**The above illustration shows a new style of proposed helicopter which has a separate engine in each of the vertically acting foils and also an engine and propeller for propulsion.**

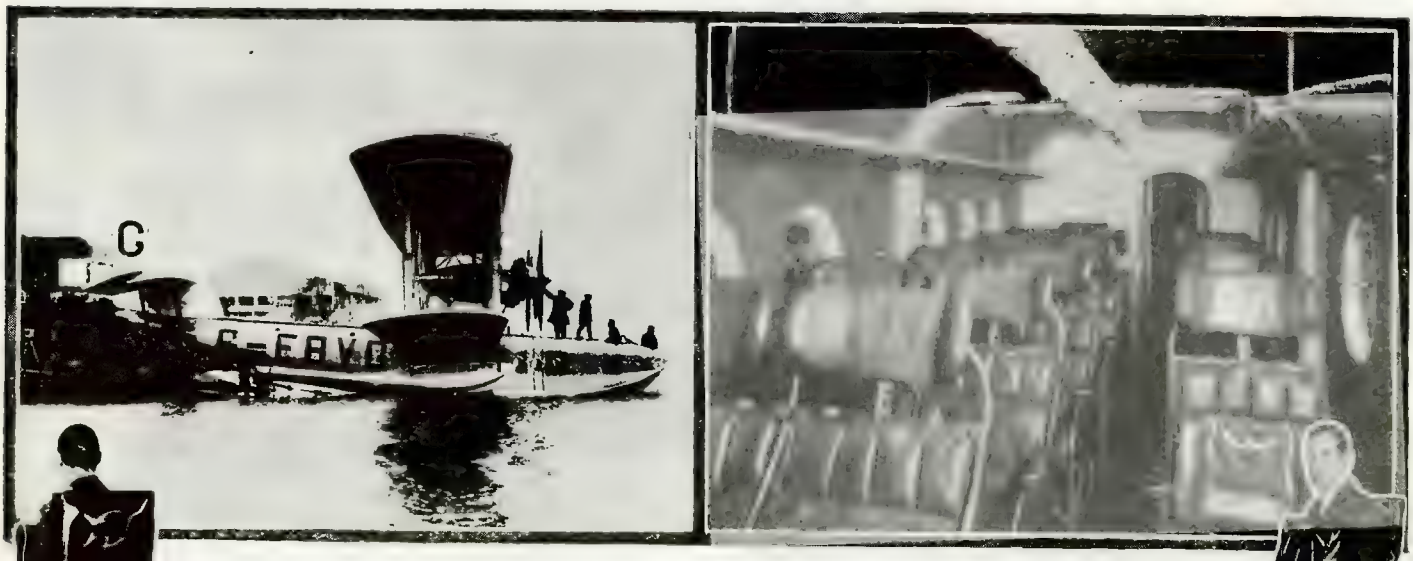
THE world is looking forward to new developments in aircraft, and possibly even getting more than it expects in the way of radical departures from present styles. Aviation enthusiasts believe that the only solution to the problem of popular flying is the development and successful demonstration of vertical flying machines. These machines will have to be able to rise from a limited tract of land and come to rest in the same space. In addition, they will have to proceed at a speed of approximately sixty miles an hour and be absolutely safe, even in the event that the engines should stop.

A prominent eastern aircraft corporation has announced their intention of proceeding to develop the vertical-rising aircraft illustrated on this page. This consists of two air foils or modified propeller blades, mounted at the end of cross arms, and each of the foils is to be provided with its own engine and propeller. These areas are to provide the lift, and they both turn in opposite directions, as the diagram indicates. Instead of tilting the airplane, in the usual method in order to produce a horizontal flight, a propeller and engine for propulsion is provided. The airplane itself will also have a plane surface large enough to permit the craft to glide to the earth, in event of accidental stoppage of any or all of the motors.

The well known electrical wizard, Dr. Nikola Tesla, has invented a new method of aerial transportation, explained in his patent No. 1,655,113. The details of this are also indicated on these pages. Dr. Tesla states that the helicopter type of flying machine is quite unsuitable for speedy aerial transportation because of the large inclination angle of the propeller axis to the horizontal at which the ordinary types are expected to operate. He further holds that these machines are incapable of proceeding horizontally along a straight line under prevailing air conditions, that they are subject to plunges and oscillations, and almost certain to be doomed to destruction in case the motive power gives out. In his own system, the construction is composed of two planes rigidly joined. The tail is omitted for the sake of smallness and compactness, or if used, is retractable by simple means.

As motive power, Dr. Tesla intends to employ the turbines which he invented some years ago and which were fully described in the July 1920 issue of this publication. When the mechanism is at rest, the planes and the driving propeller will be vertical. The operator or passengers are suspended on trunnions which can turn through an angle of about 90 degrees. The usual devices for lateral and directional control are provided to enable the operator to actuate them by foot or hand.

At the start, sufficient power being turned on, the machine will rise vertically in the air to the desired height. When it is gradually tilted by manipulating the elevated devices and proceeds like an airplane, the load being transferred from the propeller to the foils as the angle of inclination diminishes and the speed in the horizontal direction increases. It will thus be seen that with the tilting of the machine, the operator will increase the thrust of the propeller in order to compensate for the reduction of sustaining force which follows as the plane tilts, and before the reaction of the wings can come into full effect. He then gradually cuts down the motive power as the machine gains in velocity. From this point on, the operator can proceed to his destination and on reaching this, the same mode of bringing the machine to a rest is employed. Here the operator causes the machine to again rise in the air and permits it to gradually settle down, as he decreases the thrust of the propeller or the speed of the engine. It will again be observed that at this point the load is being carried primarily by the propeller.



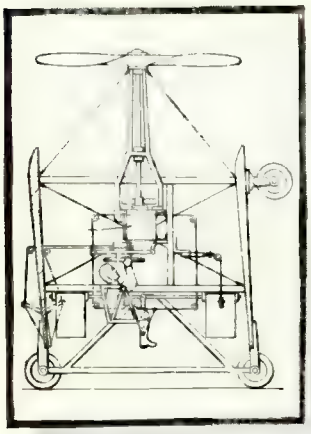
**The photograph above shows a new giant all-metal British seaplane which has just been put into service. It will carry fifteen passengers and their baggage, and is fitted with safety appliances.**

**The interior seating arrangement of the new British seaplane. The seats are so arranged that they house both life preservers and parachutes, both of which can be instantly strapped to the occupant.**

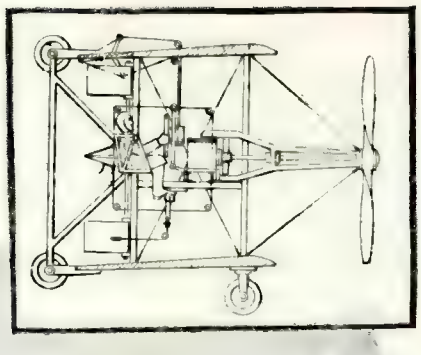
**The photographs here show the world's largest seaplane liner. It is equipped with three 485 horsepower Jupiter engines, and is made entirely of metal. It is completely equipped with every convenience for the passengers, including dining and culinary service. The seats are air-filled, and comfortably hold the life belt and parachutes for a forced departure from the plane. The photographs on either side show one of the seats and the equipment strapped to a passenger. The immensity of this plane can be estimated by comparing with the men standing on the vessel.**

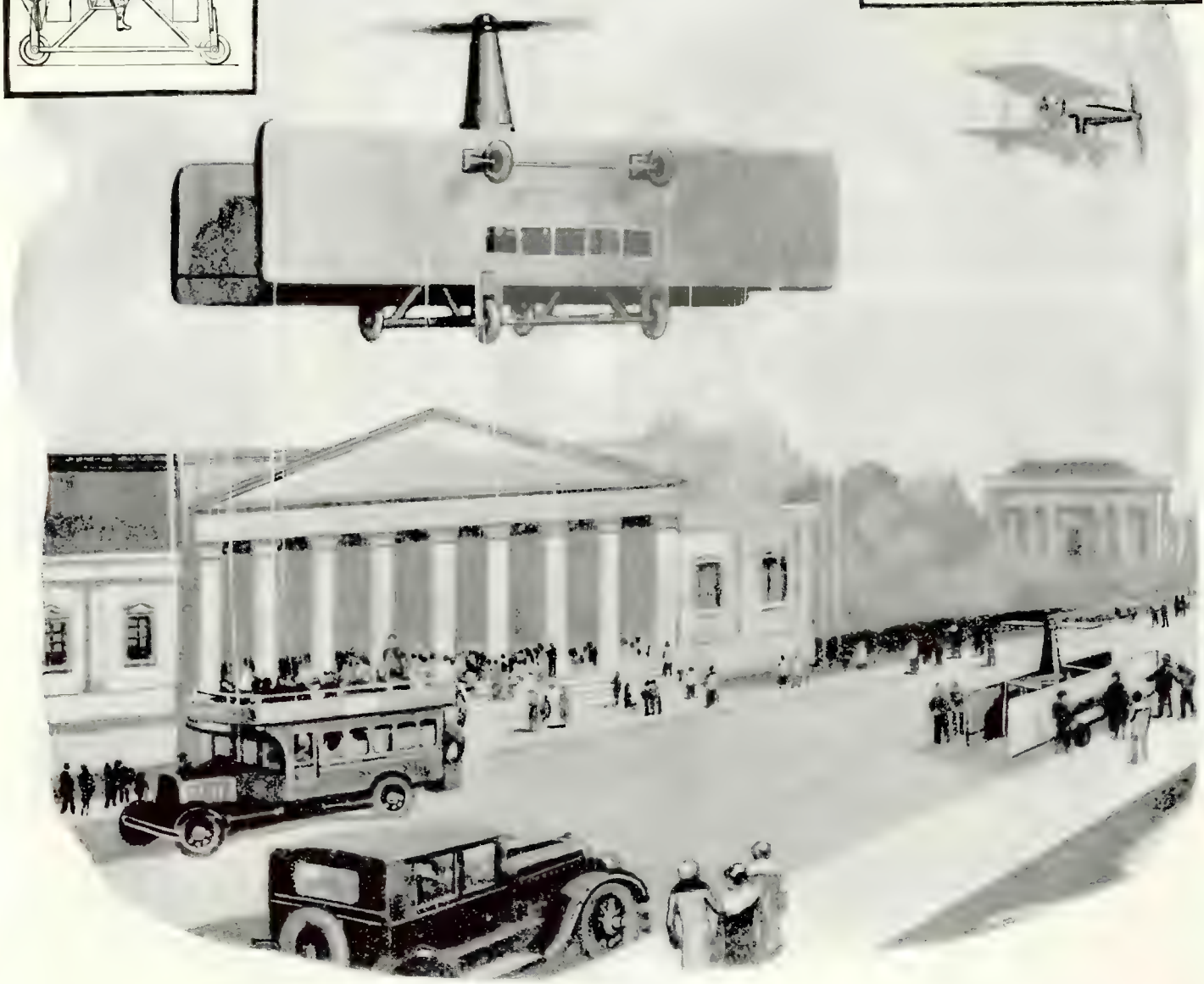
# and Safety Planes

## Making Flying Safer and Toward the Development of Vertically Rising Machines.



Below is an artist's conception of the vertically-rising helicopter invented by Dr. Nikola Tesla as it would appear in flight, at rest, and taking off. At the left are the details of the mechanism as it would appear when an aviator attempts to arise or alight. Speeding up the propeller and tilting the plane, he assumes the position indicated at the right and proceeds along his flight.





It will be observed that any type of a gasoline engine could be employed in a helicopter of this nature, but Dr. Tesla recommends the use of his gasoline turbine because of its lightness and because it lends itself to this kind of work, for which the modern types of engines might be unsuited. His own turbine is capable of carrying a great overload and of running without danger at excessive speeds so that during the starting and landing operations, the necessary power can be developed by the motors. At the same time there is always a surplus of power which can be employed if the operator desires to greatly increase his forward speed. The illustrations on this page show the machine as it would appear at rest, with the propeller in a vertical position and the same plane in horizontal flight. No tail is here indicated, but if one were to be employed, it would as mentioned before, be quickly retractable.

And in London, developments along the line of passenger aircraft are rapidly proceeding, with every safety appliance imaginable being included and everything being done to accommodate the passengers. In these large planes the seats are now fully equipped with both parachutes and life preservers, so that in the event the passengers have to leave the plane because of an emergency, they can step out of it, even while it is in flight and negotiate a perfectly safe landing. These planes are all-metal built.

The ability of metal planes in carrying out successful long distance flights is exemplified by the German plane the "Bremen," the first to cross the Atlantic from east to west. The flight was from Dublin, Ireland to Greenely Island, Canada, with Baron von Huenefeld, Herman Koehl, and James Fitzmaurice.

# X-rays Aid to Industry

## The Metal and Other Parts of Machines Are Now Frequently Examined by X-rays, Which Disclose Impurities, Air Holes, and Other Defects

By HERBERT R. ISENBURGER

X-RAYS do provide us with a means of seeing into and learning a great deal about the interior of many articles without destroying or in any way harming them. Therein lies the immense value of the application of radiology to industry—a value which is only now beginning to be realized and which is every year being more appreciated in the commercial world.

Without spending time upon the nature and production of X-rays we will merely recall that they are of the same general character as light-waves, but so short that they readily penetrate all sorts of materials usually opaque to visible light, that they are produced commercially by a very high voltage discharge in a special type of vacuum tube, and that their ability to penetrate materials increases with the voltage but decreases with increasing atomic weight of the component materials. Thus, X-rays produced at 100,000 volts may penetrate satisfactorily an inch of steel, several inches of aluminum or a foot or more of wood, whereas more than 200,000 volts would be required to produce X-rays to penetrate three inches of steel.

Considerable use has been made of radiography for the examination of electrical insulating materials. Many of these substances, such as hard rubber, mica, fibre, ebonite, bakelite, and the various forms of compressed paper insulators, are liable to contain small particles of metal or metallic salts, which seriously detract from their value as insulators. These defects can be quite easily detected by X-ray inspection.

X-rays have been used in a commercial laboratory as a means of observing the height of a mercury column inside a steel tube. Abrasive wheels have been examined for incipient cracks which might cause them to burst when rotating at high speeds. Fireclay pots for use in the manufacture of glass have been inspected for the presence of harmful metallic impurities. Real pearls may be distinguished by their fluorescence under the rays, and imitation precious stones, which are frequently made of glass of high density, may be detected by their opacity when compared with the genuine article.

Most golf balls contain a dense central core. Nobody would think of using a golf ball of which the exterior was not perfectly spherical. It is equally important that the heavy core should also be a perfect sphere, but until the use of the X-ray was thought of, even the most careful manufacturer could not be sure that the core had not been distorted in the final stages of manufacture. All he could do was to cut up (and so destroy) a certain percentage, as a rough check on his manufacturing methods and hope for the best with the remainder. Nowadays certain manufacturers inspect their whole output by the simple method of allowing the balls to roll between an X-ray tube and a fluorescent screen, with the results shown.

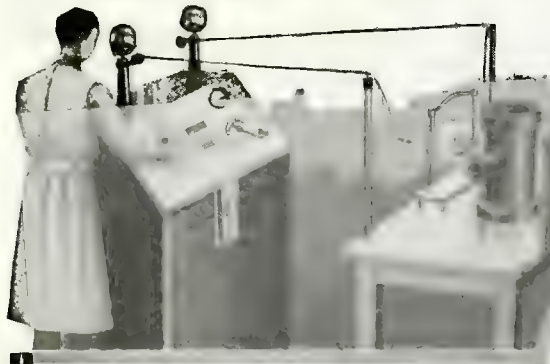
The routine examination of cast fittings for high-pressure steam plants, oil stills, and the like is becoming of such moment that the American Society for Testing Materials is proposing a *Recommended Practice for Radiographic Testing of Metal Castings.*

The strength of glued wood joints is very important in aeroplane construction. It depends largely on the even distribution of the glue between the two surfaces. A very thin layer of glue has very little opacity to even soft X-rays, so that it is hardly shown in an exograph, but it may be rendered visible by adding some inert heavy substance, such as lead salt, to the glue before it is used. The addition of 5% or 10% of lead sulphate to the glue appeared to result in rather a slight increase in the strength of the joint. The glue was thus rendered plainly visible.

Shell fuses are carried in holders arranged to fit around a semi-circular protective tube box, from which the X-rays can only escape through a narrow slit of the same width as the fuses. The exposure time varies from a few seconds up to about a minute, and some hundreds of fuses can be dealt with every hour. This X-ray method supplants the ordinary methods of inspection in every way.

Serious wastage in the machine shop often occurs because of internal defects encountered after considerable machine work has been done. Serious claims for damages are sometimes made because internal defects which are not encountered before have caused a subsequent failure in service. While these conditions are perhaps more prevalent in

(*Continued on page* 175)



The X-ray apparatus shown at the left is being used for examining the metal casting, which is placed between the X-ray tube and the photographic plate holder. Shielded type X-ray tubes are usually employed.

Fig. 2, at the left, shows an X-ray photograph of an aluminum casting. Thanks to the X-rays, the presence of air or blow-holes in the casting are made manifest by the white spots. Fig. 3, at the right, shows the heating element of an electric flatiron. The black spots indicate metallic particles in the mica insulation. The mica should be free from metal.

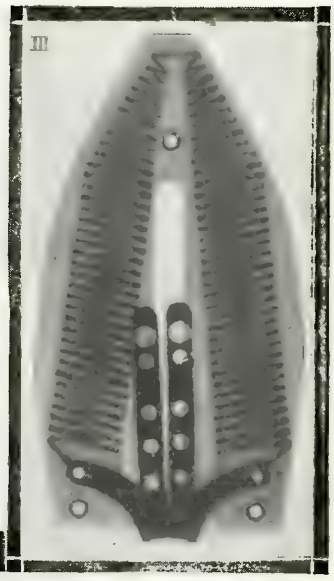


Fig. 1, above, shows a zinc casting in which air bubbles are indicated by the irregular white spots. For many purposes, it is important that castings be free from air holes. Fig. 4, at the left, shows metal (dark spots) in fiber shell insulation taken from a lamp socket.

Fig. 5, at the left, shows why the golfer may frequently pay a good price for his rubber golf balls, but they may fool him when he tries to make a long drive. The X-ray machine proves very valuable in the golf ball industry, for it discloses the interesting fact that the core of the golf ball may be any shape except spherical; also the core may be placed off center with regard to the outer rubber shell. There are many other branches of industry in which the X-ray is practically indispensible.

# New Belin Photo-Transmitter

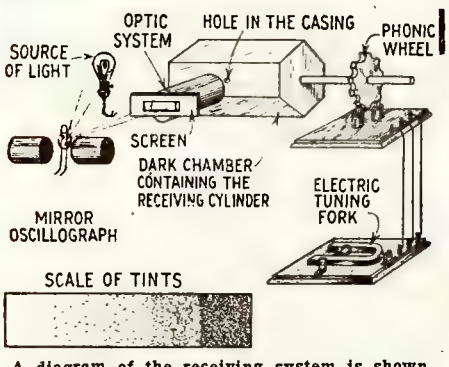
## Interesting Description of a Clever Method of Synchronizing Transmitting and Receiving Photo-Telegraphic Apparatus

By LUCIEN FOURNIER

PERIODICALLY, M. Edouard Belin is brought to the notice of the scientific press. This inventor of a surprising fecundity has often astonished us by what he has done, his first achievements being in the line of photo-telegraphy, of transmissions of photographic pictures by wire at first, then by radio. The transmission of autographs and drawings marked the extent of his progress so well, that now for several years the public has been able to utilize the Belin apparatus for sending autographic documents in certain cities.

Nevertheless, the new invention, interesting as it is, has not attracted the public's attention as much as we might have wished. The first reason is that the French Administration of Posts and Telegraphs hesitated in developing the new telecommunication on its wires, because of the high price of the apparatus. And then the public generally nonreceptive to any effort, whose utility they fail to recognize, was only slightly interested in the inovation. Having to write their "Belinogramme" on a special surface with ink also of special preparation, they preferred to adhere to their old custom and to put their message on paper without having to translate their chirography into printing. The inventor understood all this and in order to triumph over one or the other of these resistances, it was necessary at the one time to simplify the apparatus and get away from the process needing embossing ink. All this is done today.

I will not recall the principle of the preceding apparatus, described already in these columns. They were more mechanical than electrical, while those which are being constructed today relate almost exclusively to photo-electricity.

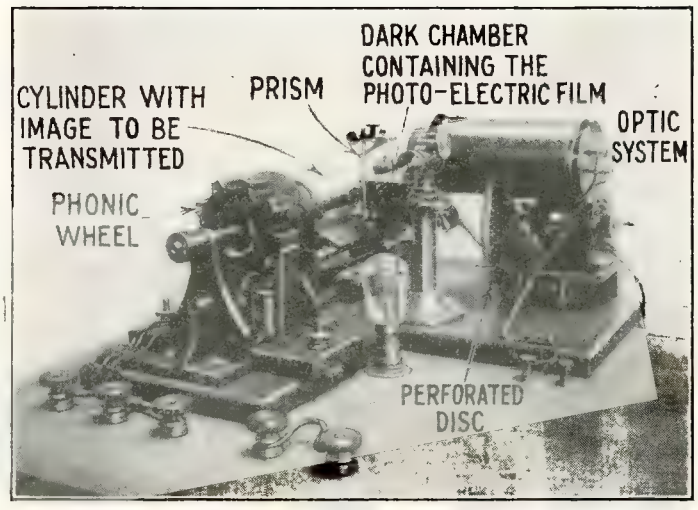



**A diagram of the receiving system is shown above. An ordinary sheet of sensitized photographic paper is rolled upon the cylinder, which is placed in a dark chamber. All tints of the transmitted photograph are received in their exact value.**

### HOW THE TRANSMITTING SET OPERATES

ON a cylinder driven by a phonic wheel, which is regulated by a tuning fork, driven electrically, an ordinary photograph is rolled, face outwards. This cylinder, during its rotation, is given a helicoidal motion. If in place of a photograph, an ordinary telegram, written with any ink is placed on it, the system still operates. It transmits one or the other document without their having to receive any modification.

Facing the cylinder is a small dark chamber, containing a photo-electric tube; it is terminated by a cone, pierced with a hole,




**A photograph of the photo-telegraphic transmitting apparatus is shown above with the various parts marked upon the photo. The cylinder during its rotation is given a helicoidal motion. Either photographs or writings may be transmitted with this apparatus.**

which faces the document to be transmitted. Every light ray passing through this hole reaches the photo-electric tube, which represents in a sense the seat of a current, whose intensity will be proportional to that of the light.

You must remember *en passant*, that the photo-electric cell carries a potassium cathode and a tungsten anode. If a negative charge is applied to the cathode, there is an emission of electric corpuscles between it and the anode, when a light ray, however feeble it may be, reaches the system. This cathode current permits the working current applied to the plate to cross over the vacuous space between the two electrodes. (The Edison effect.) The photo-electric cell becomes then a conductor of current and closes the electric circuit. It is opened automatically when luminous emission ceases to affect it, and its conductivity is proportional to this intensity. So that if we modulate the luminous beam, the current passing through the tube will also be modulated.

In the new system, the luminous ray which enetrs the dark chamber is a reflected ray, not by a mirror, but simply by the photographic image or by the ordinary white paper, if handwriting is to be transmitted. The process employed is the following:

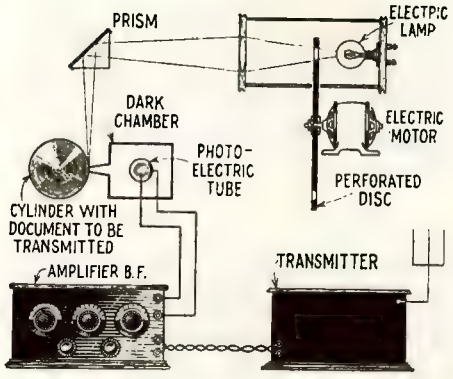
An ordinary electric lamp contained in a tube sends out a luminous beam to a prism, which reflects it upon the cylinder at a point exactly in front of the hole in the dark chamber, and appears as a luminous spot upon the document. When a white surface comes under the luminous spot, it reflects a great part of the light received, but if the white surface gives place to a black surface, the light is practically completely absorbed, and no reflected ray penetrates the dark chamber. In this case we will obtain a total emission of light, followed by a total interruption. And the photo-electric cell will be first traversed by a current of maximum intensity, and then will cut off this current sharply. And this is the phenomenon which is produced when an autographic dispatch written in black ink on white paper is to be transmitted; total emission under the action of the reflected ray and total interruption when a spot of ink comes in front of the dark chamber.

The system will operate the same way in the case of photograph transmissions with this difference, that the image is formed by tints, more or less accentuated. The reflected ray will be subject to the influence of the various tints and the action on the photo-electric cell would be modified in consequence. This will then become the seat of variable current more exactly of a modulated current, whose strength is precisely proportional to that of the reflected ray.

But this current, being very weak, it has to be amplified for its transmission whether by telegraph or telephone wires, or by the use of transmitting radio sets. This amplification is facilitated by the transformation of this current, modulated but continuous, into a periodic current which is developed by simply acting on the ray as it leaves the lamp.

For this purpose there is interposed in this ray a wheel driven by an electric motor, whose periphery is perforated by a certain number of holes. We thus obtain a current modulated periodically, that is to say, with rapid breaks 800 to 1000 periods per second, reproduced by the reflected ray and accentuating the amplification.

As the cylinder has a helicoidal motion, all points of the image attached to its surface are explored by the direct ray, and give rise to a reflected ray, whose intensity




**The above illustration shows clearly the arrangement of the apparatus and how it is coupled to the radio transmitter.**

will depend on the tint of each one of these points. The electric current emitted by the photo-electric cell under its influence, undergoes the same variations which will be conveniently amplified before being used as active transmitting currents.

(*Continued on page* 174)

# Mysteries of the Air

## Study of Air Currents Teaches Us Many New Things

THE desire of man to fly at high speed through the air is of great antiquity. But the gulls in their playful elegance perform the motorless sweep and skimming, to which man with his feeble efforts has not yet attained. Neither Icarus of legendary history, down to the surpassing engineer, Leonardo da Vinci, obtained the least success. Newton, one of the greatest scientific thinkers of all times, who laid the foundations in so many realms of natural science investigation, even he was all wrong in everything he said about the action of the air.

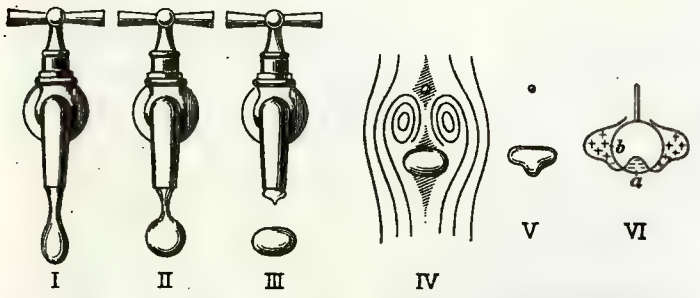



Fig. 1—The form of the falling water drop is changed materially by the resistance of the air.

And yet we are here dealing with a medium that surrounds us every day, that is as essential to our life as is the water we drink. We have no need to create our material to experiment with as we do with electricity, although it is only in the last few years that we have understood it. We trust ourselves entirely to its action. Micrometric preliminary calculations of electric operation has made possible the construction of giant machines that can carry a load of 50,000 kilowatts and more. In their last and very finest developments the electric action in almost unimaginable current strength is used. The air is present at all times and in all places, without expense, standing ready at hand; nevertheless the air gives us one riddle after another. The chemist goes to it and behold Ramsey in the last decade finds five new "noble" gases in the air, of which helium, the unburnable, the valuable inflating material for dirigibles, is the one most familiar to all. In the last century chemists and great scientists always maintained that the air consisted essentially of nitrogen, oxygen, and traces of carbonic acid gas. They based their wonderful and exact chemical calculation on this basis. It suddenly was found that these bases of observation were more secret and hidden than science had believed during past centuries.

### MAGNITUDE OF AIR PRESSURE

STILL more completely does the physical riddle of the air hide itself from the understanding of investigating mankind. How short a time in the history of natural science has passed since the first experiments of Otto von Guericke who showed how great was the weight of the air. Two copper hemispheres as large as the smallest kettle drum were placed together, and the air was pumped out and sixteen strong horses could not pull them apart, so great was the weight of the air pressing upon them. It seemed incredible to the people present at the experiments of the burgomaster of Madgeburg, that the air at which we can grasp without resistance, rests upon our shoulders with hundred-weights of pressure. That the motion of this weight can exert great force has again been brought to our attention in an impressive way by the storms in Florida. This storm blew whole cities away in a few minutes. Skyscrapers fell down like card houses.

### STUDY AIR WITH WIND TUNNELS

SCIENCE for a long time has endeavored to investigate the power of this force to make it of use to us and to protect ourselves from these natural forces. We look over a field of grain, and see the waves of wheat roll through it wild and unbridled. A skillful observer observes in it that the tree or a growth of wheat acted on by the wind casts a long "wind shadow," in which there is no or at least an entirely different movement produced. The waves of the growing grain represent the whirlwinds of the air driving through them, which in some way or another may be said to have the size and form of an elliptical wool bag. The science-searcher stands in doubt before the wind-measuring instrument of our modern weather station, and sees how the index charting the wind velocity gives a trace ceaselessly of zig-zag form over the smoked paper. How can he determine the power and measure it when he knows that the velocity of movement varies with the square of the velocity? He tries to bring all these appearances into accord with a wind velocity, and believes that he has brought his measurements down to a velocity of two meters per second, but at the very point where he measures the wind and puts it down at two meters a second, immediately after, perhaps only a fraction of a second later, the air moves at two and one-half meters a second. He is over twenty per cent wrong in his measurements. The square of two is four, and the square of 2.5 is 6.25! At last he has succeeded in producing a perfectly constant stream of air artificially in the so-called wind tunnels. After years of assistance from small wind tunnels, it first in the great war became possible by using larger materials to produce the largest and most effectual wind tunnel of the world in the city of Goettingen. The flag blowing out from its pole and the so-called streaming out of the wind tunnel are scientific acquaintances of the latter years.

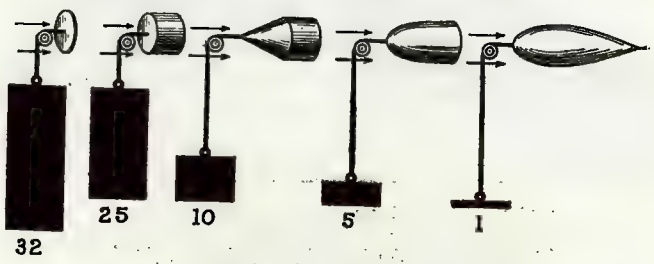



Fig. 3—Influence of the form of the body on the air resistance, which here for comparison is indicated by black weights. As we see, the resistance on the simple disc to the left, is about 32 times as great as that on the stream line Zeppelin model of the same cross-section.

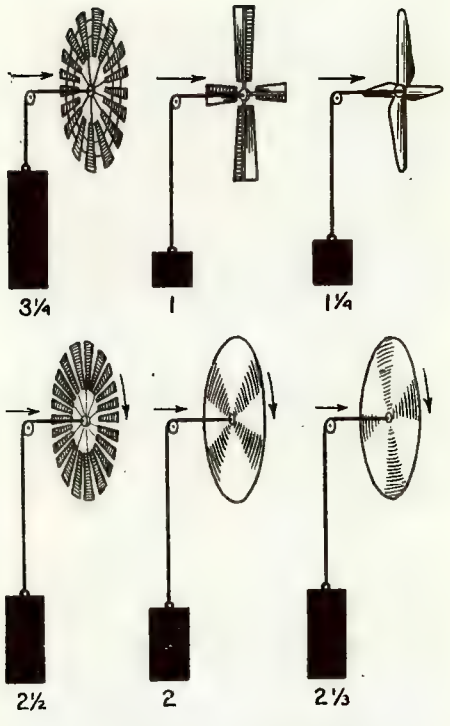



Fig. 5—The amount of wind pressure exerted on motionless (above) and moving (below) wind-wheels are indicated by black weights; left: wind-turbine; center: wind-mill; right: Venti-motor.

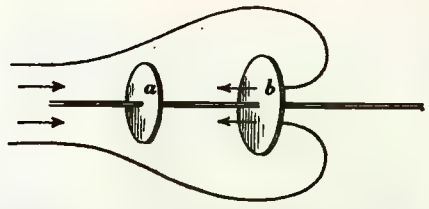



Fig. 2—A simple but surprising experiment: if one blows against the fixed disc *a* on the wire, the movable disc *b* back of it will not be blown away, but will be drawn towards *a* by the suction.

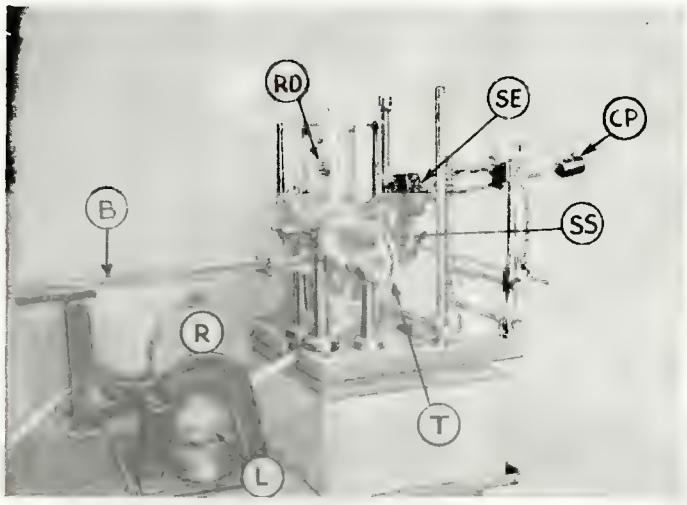
### SHAPE OF WATER "DROP" IN AIR

HUNDREDS of thousands speak today with great self-confidence of the "drop" formed Zeppelin airship, but very few know that drops of water falling through the air have a far different shape. The last drop hanging from a recently closed water faucet, Fig. 1, has approximately the so-called "drop" form, but this drop is hanging in motionless air, and only holds this form for a few seconds. It would be better for it if it could imitate the sun, moon and earth, and keep itself pulled together into the spherical form indicated for it by nature. As far as it can it tries to keep the form of a sphere. The thread of water holding it becomes thinner and thinner, Fig. I, II, and finally breaks loose from its fetters (Fig. I, III). Now comes a surprise. The air acting against the falling drop restrains its fall, the under side holds practic-

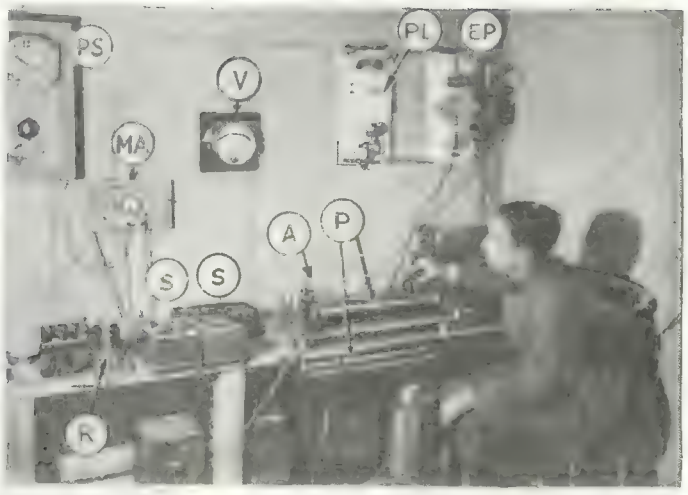
(*Continued on page* 179)

# Self-Regulating French Clock

By LUCIEN FOURNIER
*(Our Paris Correspondent)*




**In the above photo B is the paper band for recording, R is a water reservoir, L the lamp which deposits lamp black on the paper strip, T is a drum over which the paper passes, RD is a regulator for the unrolling of the paper, SE is a stylus for registering the movements of the tuning fork, CP is the stylus counter-balance, and SS is the stylus for registering the seconds.**




**The above photograph shows the installation. PS is a synchronized pendulum, MA is a milliammeter, V a voltmeter indicating the voltage passing through the photo-electric cell, R is a relay, A shows a bank of three amplifying tubes, P shows the potentiometers, PL the free pendulum, and EP the photo-electric equipment.**

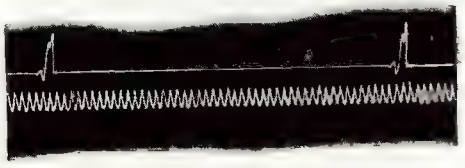
THE defects of the astronomical clock by which it mechanically produces time indications on a record, operate to impair its accuracy. To overcome these troubles General Ferrié and Mr. Jouaust conceived the idea of suppressing the driving apparatus of a master clock and replacing it by a free-swinging pendulum, and to keep this pendulum going by its own effects and to send correcting currents into the other clocks. Under these conditions all the clocks will be synchronized by an apparatus without any mechanical friction, and the oscillations, therefore, will be rigorously isochronous.

We can easily, without going into technical detail, explain the construction of the apparatus and how this system of automatic regulation operates.

On a pendulum which swings freely there is fixed a little mirror receiving a ray of light coming from an ordinary incandescent lamp. The ray of light is reflected directly upon a photo-electric tube, which our readers are familiar with, and I need only mention that the ray reaching the vacuum tube causes the passage of an electric current through the apparatus, which is the apparatus filling the rôle of interrupter. The current ceases passing, that is to say the circuit is open, as soon as the ray leaves the tube.

The period of illumination of the tube is regulated by a diaphragm E with an adjustable opening placed in the course of the reflected ray. This diaphragm limits the time of insolation of the tube to five thousandths of a second.

This current, which is very weak, is properly amplified by two stages of amplification, and then by a double grid similar to those used in radio, and goes through two coils wound in series. One of these windings belongs to the pendulum which we will designate under the name of synchronized pendulum, whose escapement is provided with a magnetized bar, which enters into the coil. The second belongs to the original pendulum arranged like the preceding one.



**Above is a section of the paper band which passes under the two styluses, one of which is driven by an electric tuning fork at 50 beats per second. It produces the effect shown on the lower portion of the paper. The other curves on the paper are made by the synchronizing device.**

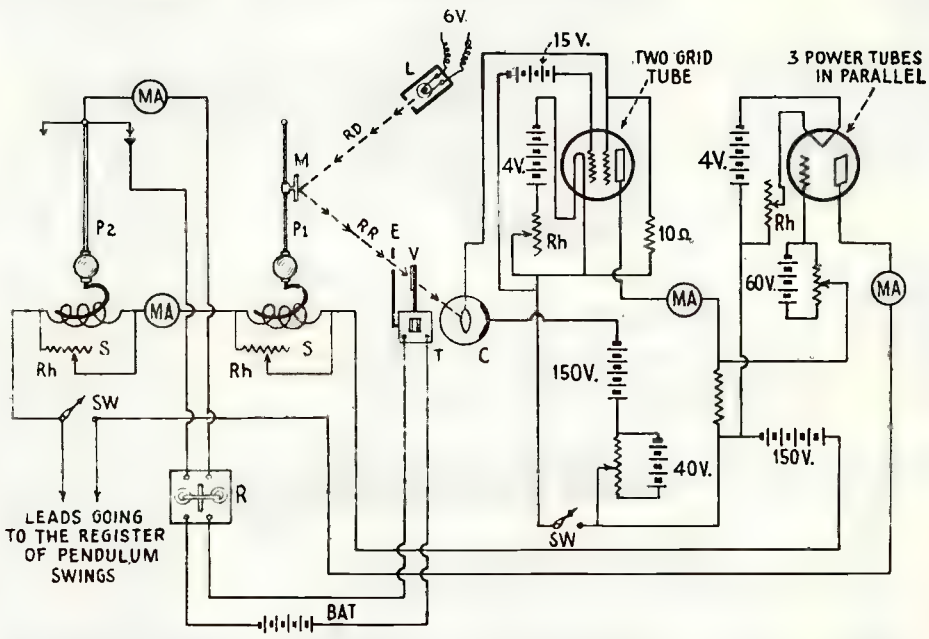
The current produced by the oscillations of the first pendulum maintains the oscillations at the same time as it synchronizes them, which as will be easily understood, is carried out without the use of any mechanical organ.

The second pendulum is also free from the influence of its own mechanism because it is synchronized by a freely-swinging pendulum. Time can be given with much better approximation than with the former process. That is to say, that in one day the advance or retardation will never exceed one-thousandth of a second. This shows the importance of the researches of these two gentlemen.

By studying the diagram more closely, our readers can see that the mirror sends two currents per second into the photo-electric tube.

There might be involved something worse than an inconvenience, because one of the currents emitted at the moment when the pendulum is passing the vertical, would exercise an action on the pendulum as it moves from right to left, and another when it returns from left to right, these currents would neutralize the oscillations and bring the pendulum to rest.

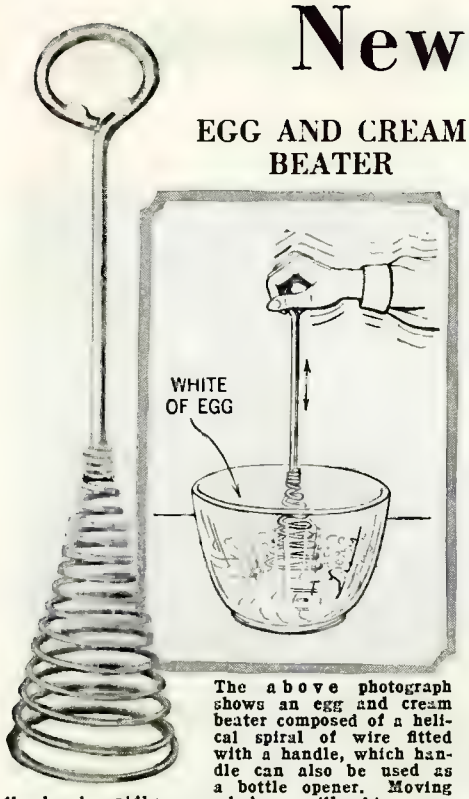
To avoid these inconveniences, the inventors have placed in the train of the mechanism a very light flywheel, governed electrically by the second pendulum, and which is placed on the edge of the reflected beam, as the pendulum is swinging back in the second period of its oscillation. The ray of light (*Cont. on page* 158).




**The schematic diagram of the self-regulating clock installation is given above. P1 is a free pendulum, P2 is the synchronized pendulum, SS are shunts, R is the relay, M a mirror, L the light source, and RD and RR are the beams of light. A vacuum tube having two grids is used, together with three power tubes connected in parallel.**

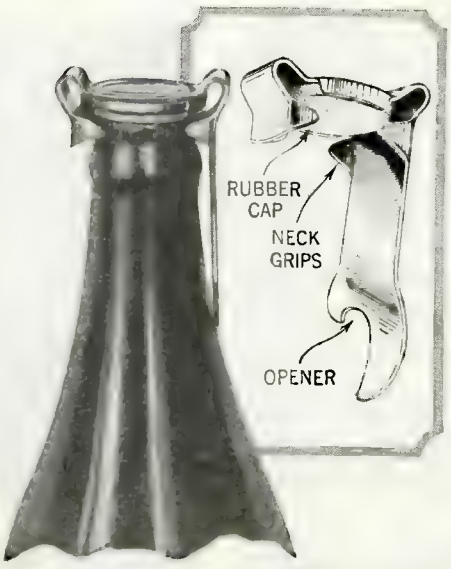
# New Devices

## EGG AND CREAM BEATER




The above photograph shows an egg and cream beater composed of a helical spiral of wire fitted with a handle, which handle can also be used as a bottle opener. Moving the hand rapidly up and down will whip cream or beat the white of egg stiff.

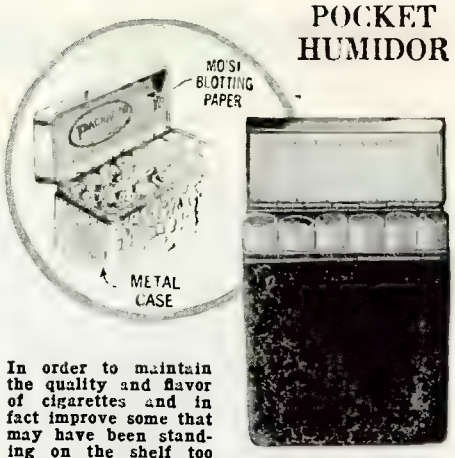
## BOTTLE CAP AND OPENER




This spring steel bottle closer produces a perfect seal for crown cap bottles. There are two grips on either half which settle in the groove beneath the mouth of the bottle. A rubber disk serves as the stopper. To release, merely lift up on the depending blade, which also serves as a bottle opener.

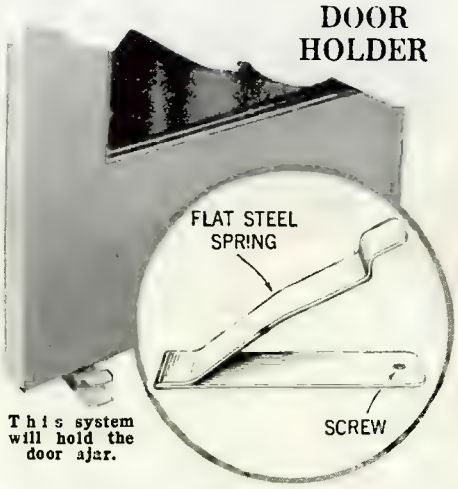
Right: A spring steel door stop which also engages the door when it swings open. It may be permanently screwed to the floor, but need not be if not desired.

## POCKET HUMIDOR




In order to maintain the quality and flavor of cigarettes and in fact improve some that may have been standing on the shelf too long, the tight metal case fitted with a pad which can be moistened as is suggested and illustruted above.

## DOOR HOLDER

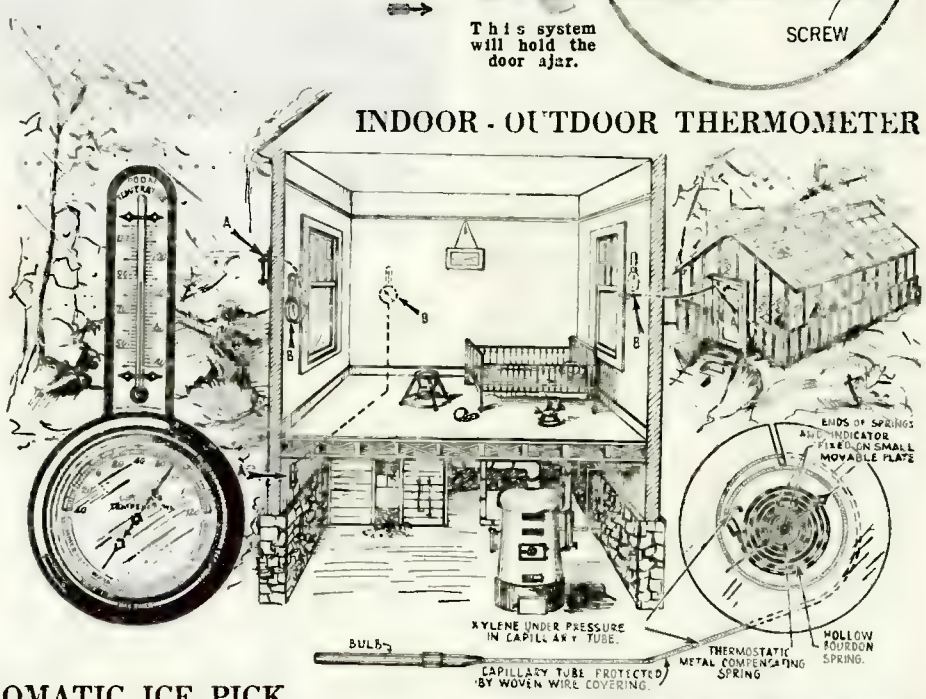



This system will hold the door ajar.

## CAN OPENER

The device illustrated above and diagrammed in use is a can opener which will accommodate round or square cans. A pair of jaws on one side grip the ledge of the can. The cutter is inserted into the can and by merely opening and closing the apparatus, the cutter can be made to slice off the entire top and turn down any sharp edge which may be formed.

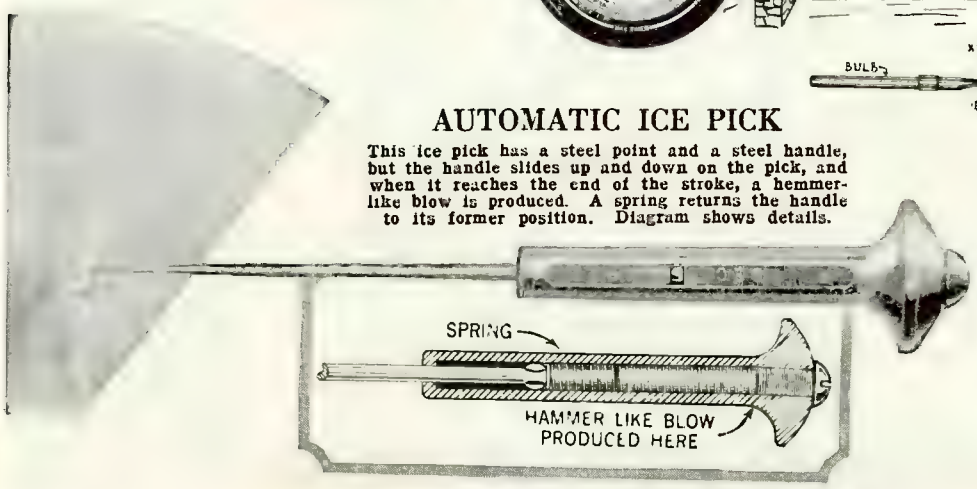
## INDOOR - OUTDOOR THERMOMETER




Here is a unique combination. An ordinary thermometer registers the temperature in the room and the circular disk beneath this is calibrated in degrees of Fahrenheit temperature and also in terms used to indicate the type of temperature. There is a small metallic bulb fitted to the end of a capillary tube which is placed outside the building or in the distant place where it is desirous of keeping track of the temperature. The diagram indicates its use in the nursery or recording temperatures occurring in the cellar or in the hot house. As indicated in the details, there is a hollow bourdon spring, connected with a capillary tube and a bulb. When the temperature rises or falls, the contraction or expansion causes the spring to wind and unwind, moving the pointer across the scale. There is a compensating spring attached inside which prevents the reading of the temperature at the bulb from being affected by any changes in temperature in the room.

## AUTOMATIC ICE PICK

This ice pick has a steel point and a steel handle, but the handle slides up and down on the pick, and when it reaches the end of the stroke, a hemmer-like blow is produced. A spring returns the handle to its former position. Diagram shows details.




*Names and addresses furnished upon request*

# "DEATH MASKS" *from the* LIVING

Here is one of the masks made by the method here outlined.

Another mask—note the completeness of every detail.

IN Berlin there is a sculptor, Micheli by name, who has mastered and perfected a method for the handling and treating of plaster-of-Paris that enables him to make some exceptional masks of living persons. There is a peculiar thing in masks of living persons that causes them to differ from those gotten from the dead, and that is, that the living person's masks always carry with them facial characteristics which are not present in the cold features of those departed.

AS will be seen from the illustrations on this page, the face is first thoroughly annointed with a rather heavy grease; particularly are the eyebrows and eye-lashes and hair treated. Thereafter plaster-of-Paris, in a liquid condition, is poured directly over the skin, a space being left for breathing purposes. Any reinforcing tapes are added to the plaster-of-Paris while it is still moist. After the mask has hardened, the subject can either be told to hold his breath for a minute while the breathing space is filled with plaster-of-Paris, or modeling wax can be here substituted.

THE mould is now removed, shellacked on the inside, and then it is filled with plaster-of-Paris, or practically any other substance which one desires. The outer surface is then chipped off, leaving the perfect replica beneath. Note the remarkable details of the features in the photographs here.

The face is first prepared by massaging cream into it as here shown.

Removing the finished mold from the face.

Plaster-of-Paris mixed with water is now poured over the face.

Chiseling the plaster-of-Paris mold from the plaster mask.

An irregular space is left through which the individual can breathe. This can be subsequently filled with modeling wax or plaster-of-Paris.

A patron examining a mask of herself. She can now use the article for determining the effect of different styles of hair-dress.

# How Hot Is The Moon?

By DONALD H. MENZEL, Ph.D.
*Lick Observatory*

FOR many years the temperature of the moon was a subject of great controversy in astronomical circles, and it is only recently that a definite solution of the problem has been given. During the period of readjustment confusion still reigns and conflicting statements are often heard. On one hand we find references to the moon as a cold, dead world, on the other we notice remarks concerning the extremely high temperature of the lunar surface. Not many years have passed since an astronomer of repute argued that the lunar craters were huge indentations in a vast field of glittering ice—which ice was the oceans of the moon frozen into a solid mass. But the only evidence he could put forward to uphold his theory was that "they look like it."

shorter than the heat-waves emitted by the moon itself and the two may be separated, as shown in figure 2 by placing a cell of water or a piece of glass in the path of the rays. Light readily passes through the two materials just mentioned, whereas typical heat waves do not, thus permitting astronomers to isolate them and measure their intensity.

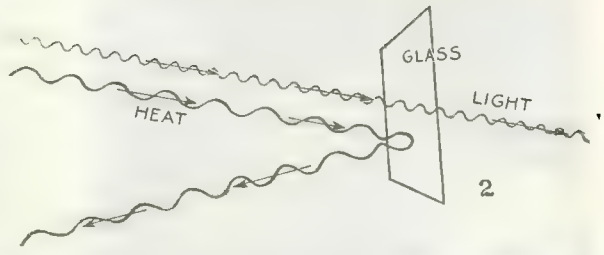
### TEMPERATURE OF THE MOON

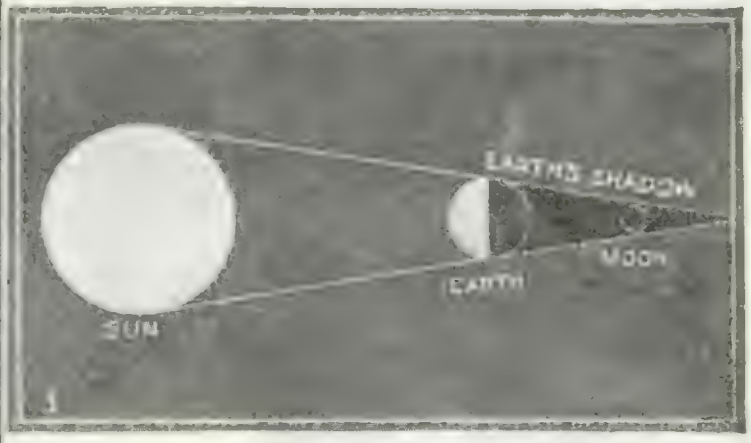
THE temperature of the hottest portions of the moon, as determined by the observations, is about 120°C (250°F), i.e., hotter than boiling water. The theory, then, that the moon is a frozen waste is more than unconfirmed; it is utterly put to rout. If we were able to transport a mountain of ice to the moon, it would rapidly melt

corresponding interval to get cold. We might expect, then, that the blaze of the lunar day would be compensated for by frigid darkness. Detzius calculated a few years ago that the temperature of the night side of the moon would fall to—80°C (110° below zero Fahrenheit) but actual measures have not been available until a few months ago, when the observations of Nicholson and Pettit, of Mt. Wilson Observatory, came to hand. These investigators find that the figures computed by Detzius, however low they may seem to be, are really not low enough, for the last named observers obtain a temperature much lower, of—160°C, 20° colder than liquid air. The point on the surface observed by them was almost directly opposite to the sun, on the midnight meridian, i.e., but half of the lunar

Above is a photograph of the moon which clearly shows the craters. The temperature of the hottest portion of the moon is about 120° C. or about 250° F.

The illustration at the right shows how ordinary glass transmits light but reflects heat waves. Thus astronomers are able to isolate heat waves and measure their intensity.




The above illustration shows how an eclipse of the moon occurs. The earth coming between the sun and the moon causes a shadow to be cast over the latter body.

### HOW HEAT OF HEAVENLY BODIES IS MEASURED

OBVIOUSLY, the only satisfactory means of answering the question is, to measure the temperature and be done with it. The earliest valuable observations of the lunar radiation were those of Very, which indicated an extremely high temperature for that part of the moon's surface upon which the sun's rays were incident most perpendicularly. Very's conclusions were not generally accepted, however, and it was not until 1923 that the measures and calculations of Coblentz, Lampland, and Menzel affirmed the general correctness of the earlier work.

The detection of heat from the heavenly bodies requires the use of an extremely sensitive instrument, known as the thermocouple—a sort of electric thermometer—which generates a minute electric current when heat from any source is allowed to fall upon it. Part of the radiation sent us by the moon is merely reflected sunlight which has played no part at all in warming its surface. The waves of light are much

in the blazing sunshine, then boil away into vapor. No need to set up a stove to cook your dinner there, when you can fry eggs upon some neighboring rock.

Why is it, one may ask, that the earth, whose distance from the sun is approximately that of the moon, enjoys so mild a climate? The answer is easily found. The moon has no atmosphere, its arid plains are marked with no oceans, while the earth has both air and water in abundance. A given quantity of water will hold about five times as much heat as the same amount of rock at identical temperatures.

During the day our oceans are storing up quantities of heat. At night, when the land loses much of its little store, the seas are a very convenient "hot-water-bottle" and their presence, aided by the blanketing atmosphere, tends to preserve a uniform diurnal temperature. On the moon, the time between sunrise and sunset, instead of being 24 hours, is fourteen times that amount, with a similar period of darkness. The barren, unprotected lunar surface, therefore, has a long time to be heated as well as a

night was over. It is not at all unreasonable to suppose that, during the days of darkness still remaining to this patch of lunar territory before it will again be warmed by the sun, the temperature will fall considerably lower than this.

### COOLING OF MOON'S SURFACE

HOW rapidly does the surface cool after the sun ceases to shine upon it? The answer to this question, too, has been given by the same observers. The last eclipse of the moon presented an unusual opportunity for the investigation. During the interval in which that phenomenon occurred, our satellite moved into the shadow of the earth (Figure 1); thus, for a few hours, the heat from the solar furnace was shut off. The temperature of the region studied was 80°C before the eclipse began. As the obscuration progressed the surface rapidly cooled until, just as totality began, the temperature had fallen to—100°C, reaching a minimum shortly afterward still lower by 20°. The extreme rapidity with which the cool-

(*Continued on page* 178)

# Raising Sunken Submarines

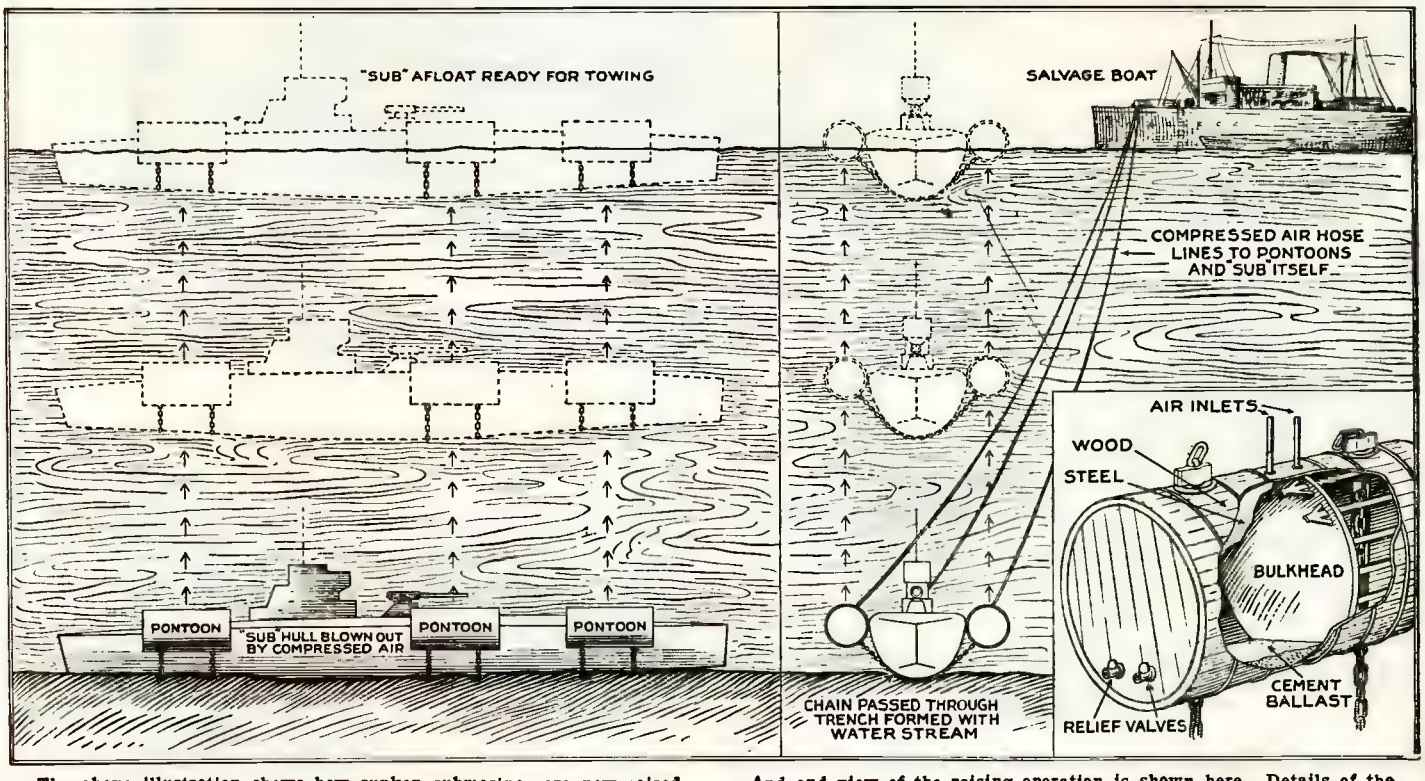
## Method Used in Salvaging S-4 Explained Here

Above is a view of the submarine as she was being towed away to the Boston Navy Yard dry-dock. The pontoons shown here were used in raising her to the surface from the bottom of the ocean, where she had sunk three months previously.

**At the right is a view of the many air lines which were attached to the pontoons, and also to the hull of the ill-fated S-4. Above the air lines may be seen a row of meters for recording the pressure. The undersea boat was recently raised from its watery grave, off Provincetown, Mass.**

**At the left is a view of the conning tower of the raised S-4, which was sunk while undergoing tests. The pontoons used may be clearly seen in the photograph, and are of steel, covered with a protective covering of wood. Six of these huge floats were needed to bring the S-4 to the surface. These pontoons have a cement ballast in the bottom, in order to keep them on a fairly even keel.**

The submarine S-4 was raised in much the same manner as was the S-51 some time ago. In both cases, pontoons were used and the submarine hull was blown out with compressed air. For the sake of clarity, we have shown the boat being raised on an even keel, but in reality, one end is raised first. Six pontoons or floats were fastened to the submarine by chains passed underneath the boat as shown. A trench formed by means of a water stream allowed for the passage of the chains beneath the hull.

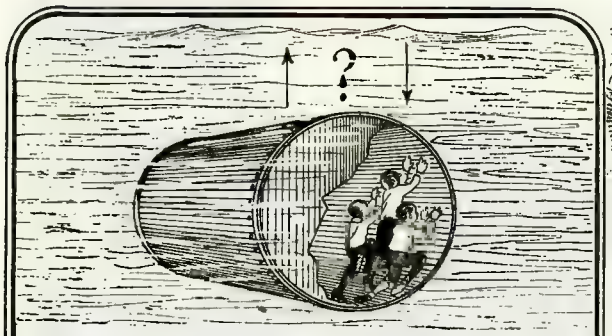



**The above illustration shows how sunken submarines are now raised with pontoons by the U. S. Navy. This method was employed on the S-51 and was again used on the S-4. "Sub" hull was blown out by compressed air.**

**And end view of the raising operation is shown here. Details of the pontoons are also shown. The pontoon is first allowed to fill with water and sink. After it has been put in place, compressed air blows the water out.**

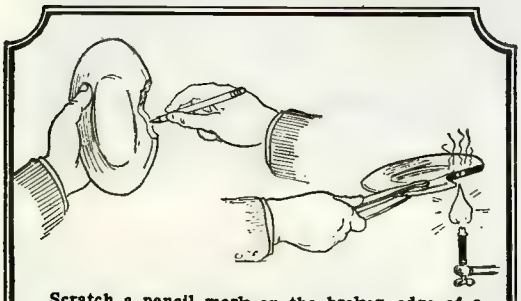
# Scientific Problems and Puzzles

By ERNEST K. CHAPIN, M.A.



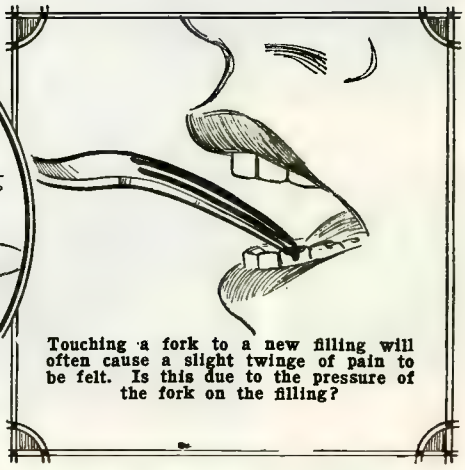
If some boys were trapped in a cylinder could they move it, by climbing up on one side of the cylinder and so set it in motion? For simplicity suppose that cylinder weight equals that of displaced water.

If a salmon can leap ten feet out of water, that is, from the surface, how fast must it have been going just before the leap?

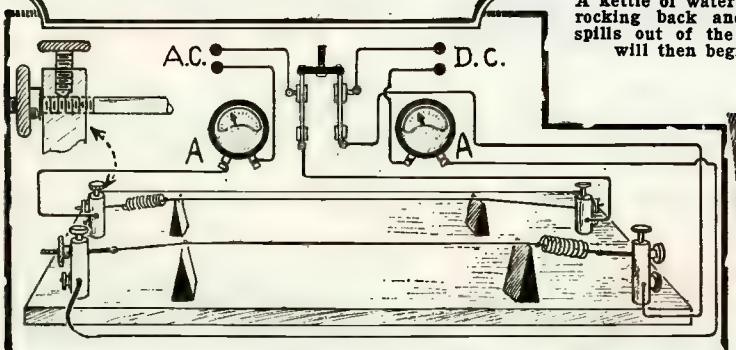


Scratch a pencil mark on the broken edge of a piece of crockery. Heat in a gas flame. When red hot the pencil mark will be brighter red than the crockery. Why?

A kettle of water will sometimes start rocking back and forth until water spills out of the spout. The motion will then begin again. Why?



Touching a fork to a new filling will often cause a slight twinge of pain to be felt. Is this due to the pressure of the fork on the filling?

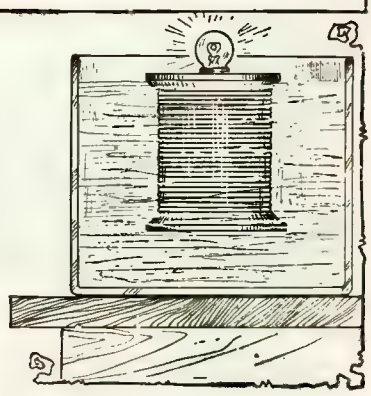



Stretch two wires over a board as shown. Connect one to an A.C. source and the other to D.C. and pass about four amperes through each. When the tension is correct the wires will vibrate. What is the cause of this phenomenon?

"I will kick you into tomorrow," said the irate ship captain to his dog. He actually did this. Can you explain how?

Three coils of wire have resistances of 2 ohms, 3 ohms and 8 ohms, respectively. How many different resistances can be obtained by using the three coils in all possible combinations of series and parallel connections?

If you saw an electric lamp fastened to a small block of wood floating in a beaker of water, what would you think was the cause of the lamp being lit, even though no battery or other source of power was connected to it? There is nothing unusual about the coil of wire, and the small flashlight bulb is simply placed on the top of the spool.



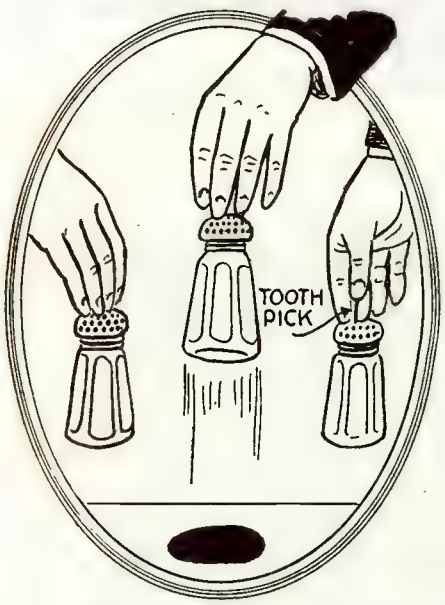
*Answers to these problems on page* 168

# MAGIC

By "DUNNINGER"

NO. 63 OF A SERIES

## MESMERIZED SALT-CELLAR




**A salt-cellar can be mystically raised by what appears to be the finger tips, if a toothpick is inserted into one of the holes as shown in the diagram above.**

HERE is an effective impromptu after-dinner trick which may be performed anywhere. No previous preparation is necessary. In effect, the wizard is seen to place his finger tips upon the cap of a salt-cellar, and then slowly raises his hand high into the air, when, to the amazement of the spectators, the salt-cellar clings to his fingers as if held there by some hypnotic force.

Explanation: The magician, during the course of the meal, finds an opportunity to secrete a toothpick beneath his finger ring. Calling attention to the salt-cellar he secretly introduces the toothpick in a hole in the top. and forces it down with sufficient force to fit firmly in the hole. The toothpick is held under cover of the thumb, with the palm of the hand toward the wizard. To free the salt-cellar it is only necessary that the pick be held firmly and the finger tips stretched a bit, forcing the object off the wood splint.

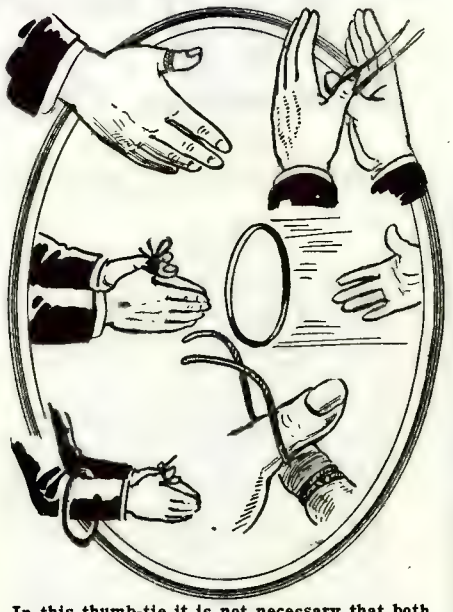
## ROPE COMEDY TRICK

PRESENT-DAY magicians so often have occasion to call up a volunteer assistant from their audience, that it is often well to take advantage of these opportunities, by introducing some comedy effect or other. In this trick the magician asks his assistant to seat himself on a chair which the wizard provides. During the course of the performance and while doing some trick, the magician sees a piece of rope protruding from the assistant's coat. Reaching down, the conjurer grasps the rope and pulls it forth. There is much merriment on the part of the spectators, when they see the development of one or two hundred yards of rope, but the assistant does not seem entirely happy. This trick is quite simple to present.

Explanation: The diagram explains all. The rope will be seen to be coiled under the seat of the chair, which has been especially prepared for that purpose. The free end of the rope comes up through the post of the chair.

**For a comedy effect, the trick shown above is a good one to try on a volunteer assistant. The rope is coiled up under the chair occupied by the victim.**

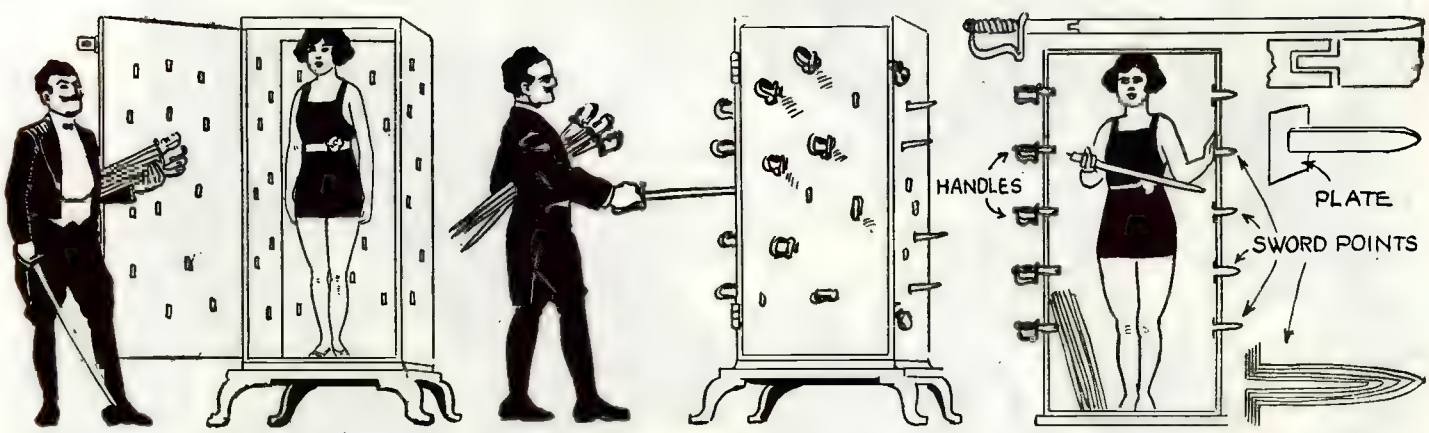
## A NEW THUMB-TIE



**In this thumb-tie it is not necessary that both thumbs be tied, yet the effect of both being tied is present and completely fools the audience. The explanation appears below.**

THE trick, wherein the conjurer's thumbs are tied, yet he is able to pass rings and other endless objects on and off the arms, requires years of practice for perfection. To permit amateurs to present the same effect, many crude methods have been produced, such as false thumbs and the like. The writer's original method is herewith described. Sash cord, such as that to be used, is wound around the thumb, tied or sewed, and the ends are then cut short. This hand is then kept out of sight until the moment of presentation. At the proper time, the hand with the tied finger is brought up under cover of the other hand. The spectator now proceeds as usual. He takes a piece of string, about fourteen inches long, and places it about the thumbs. By a slight movement, the magician frees the tied thumb and permits the loop to remain around the ropeless finger only. To the spectators, the binding seems to effect both hands. After presentation, both strings are cut with the blade of a knife.

## DEATH-DEFYING CASKET




A SENSATIONAL casket illusion.. A large steel coffin-shaped box stands high above stage level, upon a small platform. A committee is invited upon the stage to inspect the apparatus. The wizard introduces a young lady assistant, who enters the casket. The door is closed upon the cabinet, and very many swords are thrust clear through the box, through cavities made to receive them. To the spectators, it seems an utter impossibility for the young lady to escape death, under these conditions. Yet, when the swords are removed, the door is again opened, and out steps the damsel, none the worse for her "terrifying" experience.

SECRET. The cabinet is unprepared. Not so, however, with the swords. These are so constructed as to enable the young lady upon the inside of the box to remove a section thereof, while they are apparently passing through the box. To complete the illusion, a number of sword points, which have been nested and concealed in her clothing, come into action. These points are inserted into corresponding cavities in the casket, in proper angle with the swords. In removing these swords, the points are likewise removed from the interior of the box, renested, and again concealed. Only those in her path need be prepared. The others are real and may be passed for examination. Many other variations of this trick will suggest themselves to the amateur magician.

# The Metal EMPEROR

by A. Merritt

Author of "THE MOON POOL", "THE FACE IN THE ABYSS" etc.

(Ninth Installment)

## Synopsis

Dr. Louis Thornton is traveling through Tibet with his Chinese servant-cook, Chiu Ming, and two ponies that carried the impedimenta. They come upon a white man who introduces himself as Richard Keene Drake. Drake's father had been very friendly with Thornton. The three decide to carry on and come upon Martin Ventnor, a geologist, and Ruth, his daughter. The latter are guarding themselves against hundreds of soldiers who belong to an age at least twenty centuries back. While escaping they are attacked and would have been exterminated, were it not for the timely intervention of Norhala, a tall, beautiful, metallic-haired woman, whose control over lightning and over heavy metallic blocks was phenomenal. These blocks, at her command, would make a bridge for her to walk on or form themselves into battling monsters to protect her or obey her every whim. Chiu Ming is killed in the battle, the survivors leaving with Norhala. Ruth and Norhala get on one of the blocks. The others stand upon a second composed of four smaller ones joined together by their own peculiar super-normal power. The platforms speed through space at a terrific rate, arriving eventually in the court of the Metal Emperor. Angered by the influence of Norhala over Ruth, Ventnor raises his rifle and fires at the red ruby-like object he believes to be the brain of the metal monster. He is struck down by a lance of green flame and rendered unconscious. The metal monster gives Norhala the entire company to serve as her toys. She takes them to her home, where she informs Yuruk, her ape-like eunuch attendant, they are not to be harmed. Ventnor talks, then lapses into unconsciousness again. Ruth, after telling about the strange power that holds her enslaved, goes to sleep. Drake and Thornton discourse on the metal intelligences, and come to the conclusion that they are guided by some sort of group consciousness, and that they move by super-rapid molecular "steps!" Yuruk, because of jealousy, informs Drake of the way back to the city, which Ventnor, in a semi-conscious state, told them was their only hope. Yuruk claims that though the inhabitants of the city were hostile, it is much safer to escape. Leaving Ruth with Ventnor, Thornton and Drake decided to skip away from Norhala. They informed Ruth that Yuruk has learned the meaning of the pistol. After rather spectacular adventures, they come upon the Metal City, where geometrical and intangible forms are seemingly endowed with super-intelligence. The city saw and was alive. Norhala appears unexpectedly and is just as quickly blotted out from sight. They observe the metal hoards and make the acquaintance of the Metal Emperor, to be subsequently brushed out of his presence, after which they glide away rapidly.

Thornton and Drake finally come upon the birth chamber of the Metal Horde, a surprising sight. The corridor closed and pushed the adventurers off a precipitous cliff. Falling fast, they see Norhala appear. The metal cubes save the two men from destruction. Norhala tells Thornton and Drake that Ruth and Ventnor have been take captive by Cherki's men. Norhala causes the Horde to form a mighty metal dragon, which moves forward to Ruszark, the City of Cherkis. Norhala demands the surrender of the maid and the man.

### CHAPTER XXV
### CHERKIS

THERE was stark amazement on Kulun's face now, and fear enough. He dropped from the parapet among his men. There came one loud trumpet blast. What was to happen next?

From the battlements poured a storm of arrows, a cloud of javelins. The catapults leaped forward. From them came a hail of stones. Before that onrushing tempest

Quick as a serpent's tongue, a pyramid tipped tentacle flicked out beneath us. It darted through the broken circle of the bowmen. It licked up Ruth and Ventnor and—Kulun!

of death I flinched and cowered.

I heard Norhala's laughter—and before arrow and javelin and boulder could reach us they were checked as though myriads of hands had reached and caught them.

Forth from the great spindle shot a gigantic arm, hammer tipped with cubes. It struck the wall close where Kulun had dropped. The stones crumbled and fell crashing. With the fragments fell soldiers who were buried beneath them. A breach a hundred feet wide gaped in the battlements.

Out shot the arm again. It hooked its hammer tip over the parapet, and tore away a stretch of its breastwork as though it had been cardboard. Beside the breach an expanse of the broad flat top lay open like a wide platform. That arm withdrew.

From the length of the spindle thrust other arms, hammer tipped, held aloft, menacing.

From all the length of the wall arose outcry. The storm of arrows ended, the catapults were still. Again the trumpets sounded, and the crying ceased. Down fell a silence, terrified and stifling.

Kulun stepped forth, both hands held high, arrogance gone.

"A parley," he cried. "A parley, Norhala. If we give you the maid and man will you go?"

"Go get them," she answered. "And take with you my command to Cherkis—that he return with them."

For an instant Kulun hesitated. Up thrust the dreadful arms, and poised themselves to strike.

"It shall be so!" he shouted. "I carry your command!"

He leaped back, and his red mail flashed toward a turret. He was lost to sight. In silence we waited.

On the further side of the city I glimpsed movement. Little troops of mounted men, pony drawn wains, knots of running figures, were fleeing from the city through the opposite gates. Norhala saw them too, and with that incomprehensible, instant obedience to her thought a mass of the Horde whirled up into a dozen of those obelisked forms I had seen march from the cat eyes of the City.

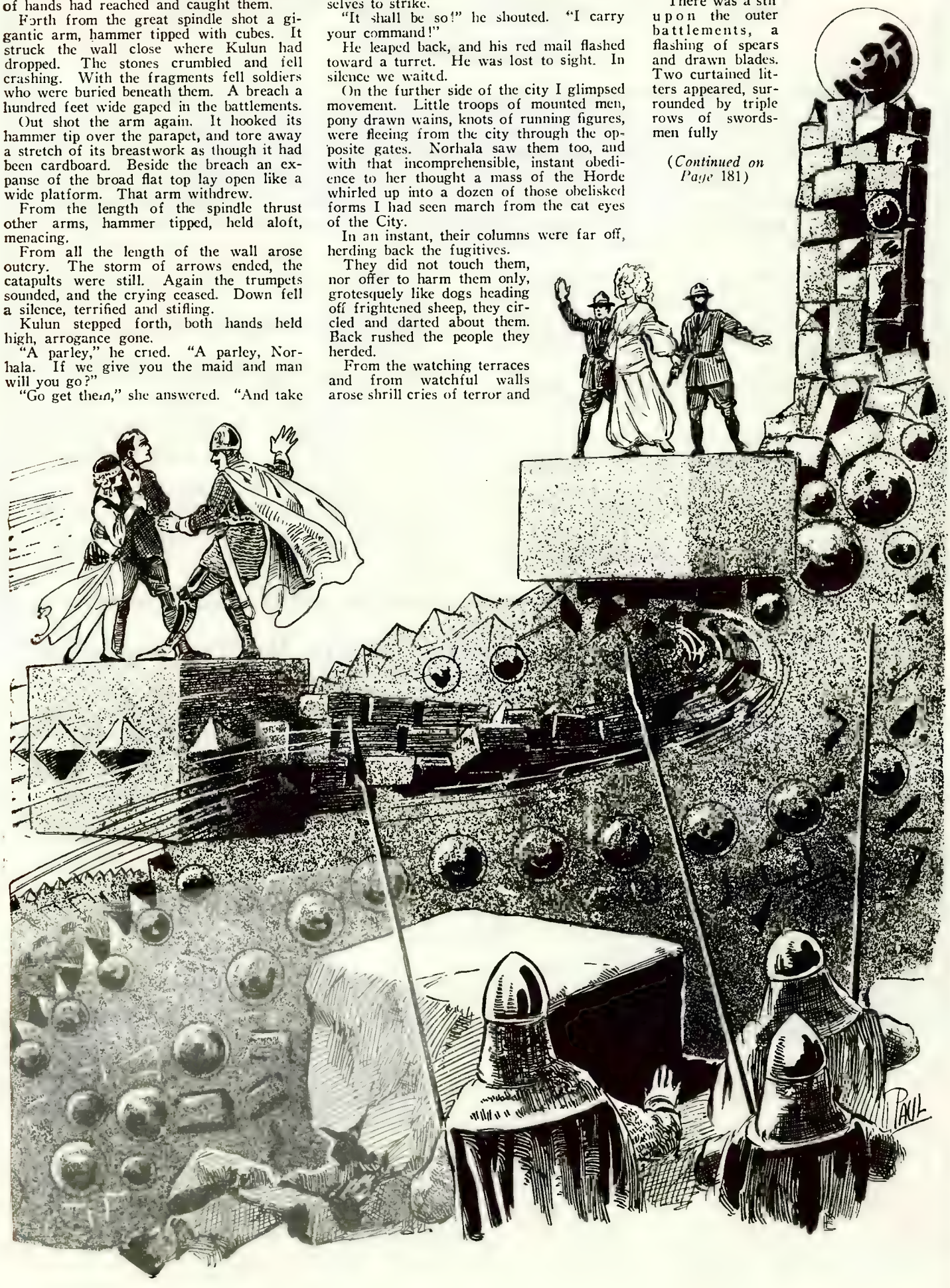
In an instant, their columns were far off, herding back the fugitives.

They did not touch them, nor offer to harm them only, grotesquely like dogs heading off frightened sheep, they circled and darted about them. Back rushed the people they herded.

From the watching terraces and from watchful walls arose shrill cries of terror and wailings. The obelisks met, pirouetted, and melted into one thick column. Towering, motionless as we, that pillar stood, guarding the further gates.

There was a stir upon the outer battlements, a flashing of spears and drawn blades. Two curtained litters appeared, surrounded by triple rows of swordsmen fully

(*Continued on Page* 181)

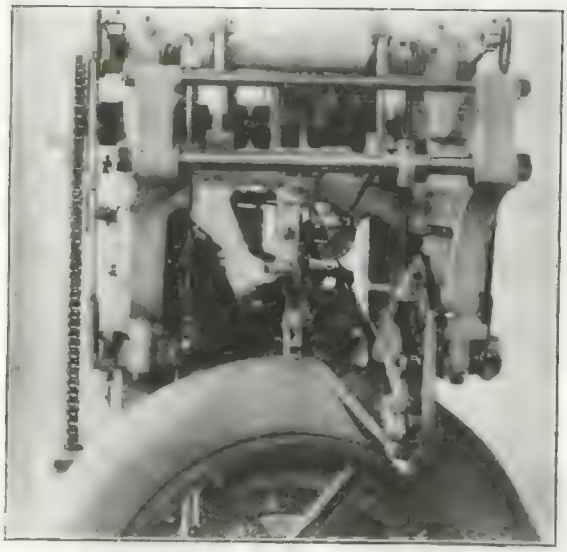


# Can You Answer These Scientific Questions?

SCIENCE and INVENTION Magazine readers, especially our thousands of friends in schools and colleges everywhere, have frequently testified in their letters to the editors that they obtain invaluable help from the columns of this magazine, in clearing up technical questions which arise daily. It is a recognized fact that everyone today, including those of both sexes, are expected to have a fairly good general knowledge of the latest scientific developments and discoveries. It is quite impossible to obtain this knowledge of the latest conquests in science from text-books, as they are usually revised but once a year, and in many cases not as often as that. You will find the questions below a good challenge to your knowledge of modern science, and we advise you to form your own answer, before you turn to the page referred to in each case.

1. Do you think that it is possible to establish communication with Mars, if it is inhabited? How would you proceed to carry this out? (See page 103.)
2. What is the length of the largest lizard that grows today? In what part of the world are they to be found? (See page 104.)
3. What is your reason for the collapse of the gigantic St. Francis Dam in California with high life and property loss? (See page 106.)
4. How many passengers will the new British dirigible now nearing completion accomodate? What is the length and diameter of the British dirigible R-100? (See page 108.)
5. From your observation of large railroad bridges can you explain briefly how a single span bridge is built? (See page 109.)
6. Is it possible to obtain three million volt electric discharges from the atmosphere when no thunder storm is overhead? How is the voltage measured? (See page 110.)
7. Can you explain in a few words how the new Tesla helicopter arises and proceeds on a horizontal course? (See page 116.)
8. Explain how X-rays are used to check the quality of golf balls? How are air bubbles in metal castings discovered by means of X-rays? (See page 118.)
9. What is the shape of a drop of water as it forms at a spigot and eventually detaches itself? (See page 120.)
10. From your knowledge of astronomy, do you think the temperature on the moon ever rises as high as 250 degrees Fahrenheit? (See page 124.)
11. In raising a submarine like the S-4 by means of pontoons, how are the pontoons sunk into place down at the wreck? (See page 125.)
12. What do you know about garden sprays? Is it possible to use one kind of spraying liquid to kill all varieties of insects? (See page 133.)

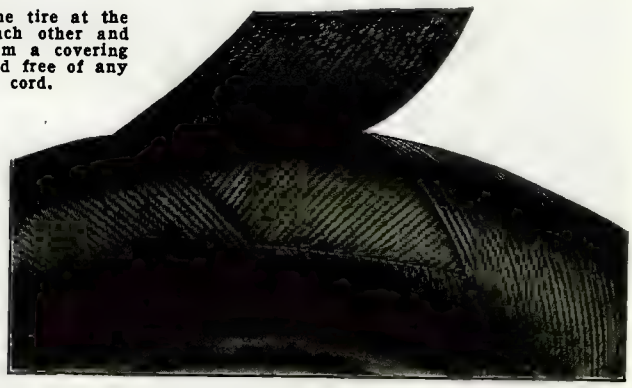
# Tire Building Machine Lays Cords With Precision



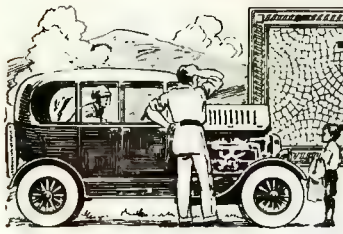
The above photograph shows a strip of from five to seven cables being laid. Note the shape of this strip. It is wide in the middle where it covers the crown of the tire and narrow at the bead end.

A TIRE-MAKING machine and process which incorporates many unique features has been developed by Mr. F. S. Dickinson. The method is different than the usual systems from its very onset. Internal friction in a tire must be alleviated as much as possible because this is a big factor in shortening the life of a tire. The cords of which a tire is made chaff against each other, and this friction is prevented in the process here described by leading the strands of the cord from spools into dies where rubber in liquid form is applied under pressure. This process saturates each thread of the cord to such an extent that approximately 30% more rubber is deposited in and around the cord than is possible with other methods of cotton impregnation. Six or seven single strands of rubberized cords are then twisted into a cable which has a hollow core filled with rubber, and the cables are then automatically formed into a cabled cord strip; which are laid as a ply of the tire by the machine illustrated on this page.

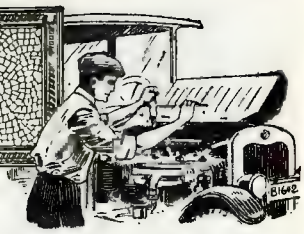
The cables laid on the tire at the correct angle with each other and all perfectly taut, form a covering that is undistorted and free of any loose or wavy cord.



This photograph shows one of the automatic tire machines in operation. The cord cables pass from the rear of this tire building machine, where they are wound on spools or bobbins over a tension device which keeps them under a uniform tension as they are laid over the tire. In coming forward, they are formed into strips of five or seven cables, depending on the size of the tire. The strip of ribbon can be clearly seen in the photograph. Now note particularly the peculiar shape of this strip. It will be observed that it is wide where it covers the crown of the tire, and narrower at the ends where it covers the beads of the tire. In shaping the ribbon in this way, the individual cords of which it is made are displaced. This is quite easily understood when one will remember that each cable has a tubular core filled with rubber, which makes it possible to displace the cable without crushing or injuring the strands or fibers of which that cable is composed. Thus there is an equal spacing of the cable at any point around the tire. There is further a great saving in the cost of construction which can, in turn, be put into the quality of the tire, by using machinery instead of manual labor for placing the cords. Between the two cord layers there is a layer of rubber which prevents the friction action here. When vulcanized, the whole becomes a homogeneous one-piece cord and rubber structure.



# Motor Hints



Conducted by GEORGE A. LUERS

## USE OF BOLTS IN REPAIRING STEERING GEAR AND SPRING

Bolts, large and small are very handy repair accessories to carry in the tool kit of the car.

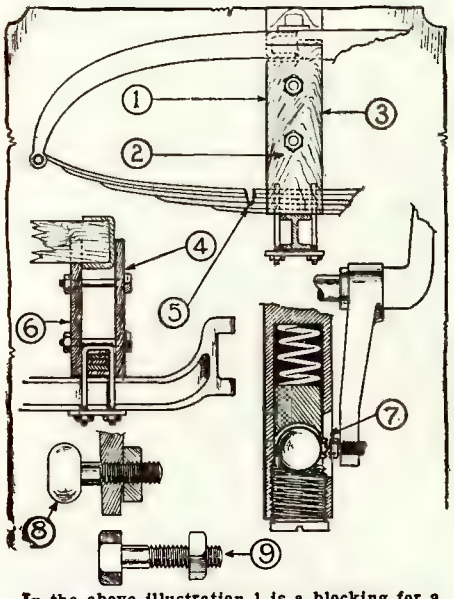
An example of a road repair, made with a bolt, is shown in the repair of the ball connection in a drag link of the steering gear.

A repair of this kind was made by one tourist last Summer, when the part broke on his car while traveling over a rocky road.

To describe the sketch: A bolt was procured, which just fitted the thread in the drag link arm.

The head of the bolt was rounded up by grinding, until it was round and smooth. This was screwed into the arm and locked with the nut. This proved an entirely serviceable repair.

Another bolt use is illustrated in the case of blocking up for a broken spring. As will be clear to one who has had the misfortune to break a spring, the car cannot be driven until the frame is blocked up, thus removing the mud-guard far enough from the




**In the above illustration 1 is a blocking for a broken spring, 2, 3, 4 and 6 are boards, 5 is the broken spring, 7, broken drag link ball, and 8 a substitute for the broken ball made from 9.**

wheel, that the wheel can turn and steering is not interfered with if it is a front spring.

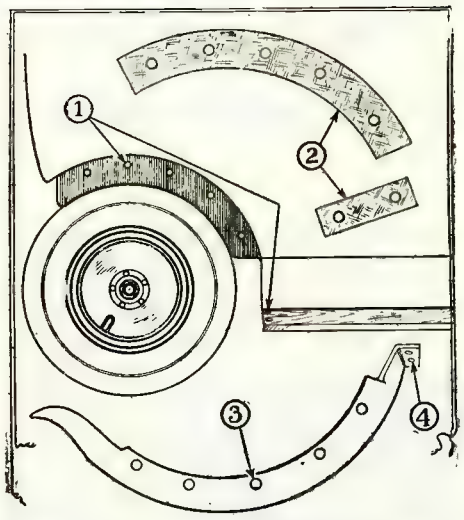
Two heavy boards can be bolted across the spring, one end of these boards resting on the axle and the upper end against the car frame.

One or two bolts serve to tighten the boards, forming a grip jointly on the spring and at the frame.

## TEMPLATES FOR FITTING NEW FENDERS

One hot morning in June of last year, a motorist of the writer's acquaintance, procured two mud-guards of the dealer and started in to replace two that were in a battered condition. This amateur succeeded in removing the old fenders, put up the new parts and set in several bolts. After much hard labor, he tried to put in bolts where the holes did not quite match. These bolts simply could not be fitted with the guard in place and it was necessary to undo the work already done, pull off the fender and enlarge the holes by filing them.

The proper procedure in fitting up new fenders to old cars, is to remove the old fenders, make up a paper template from the holes in the body and transfer these locations to the new fenders.

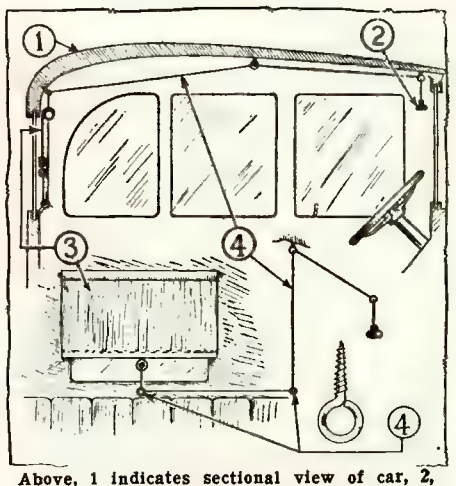



**Above, 1 indicates holes to be marked on template, 2 indicates template, and 3 and 4 show holes drilled in new fender.**

The sketch illustrates this method in which the paper template is on stiff paper, the bolt holes are carefully cut through and the template is set over the bolt holes in the new part. Where the hole spacing is slightly off, the hole is enlarged. When the template fits the fender or part perfectly, the fender can then be bolted up without further trouble. This means saves time and much hard work.

## DRIVER'S CONTROL FOR REAR CURTAIN

The car driver has frequently wished for means to lower the rear window curtain, quickly, when in traffic and lights are approaching in both directions. Lowering




**Above, 1 indicates sectional view of car, 2, knob; 3, curtain; 4, screw eyes, and linen or silk fishline.**

**DO YOU KNOW—**

**either two or four-wheel brakes squeal when the surfaces become glass smooth. Scrub with a wire brush to remove the included sand, thus avoiding the squealing and making the brakes more effective.**

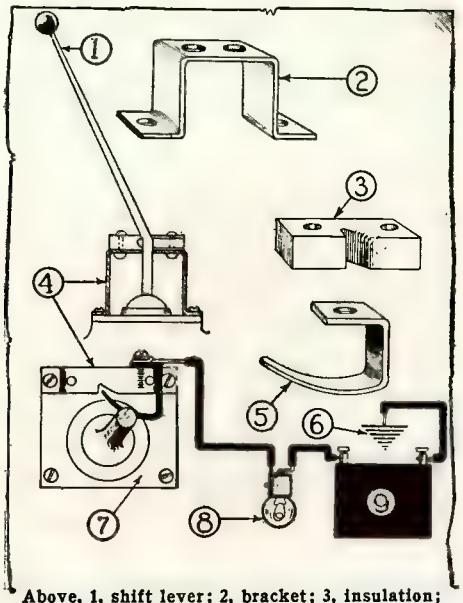
the curtain cuts off the glare from the rear car, but under normal conditions, it is desirable to have the curtain up, so that the approach of cars from the rear can be observed.

The driver's need is quickly met with a simple pull, shown in the attached sketch.

A length of silk or linen fish line, put through nickel-plated screw eyes, in the locations shown, provides a remote control for the curtain. A small knob on the cord, just forward of the driver, permits him to raise and lower the curtain at will.

## AN AUTOMATIC BACKING LIGHT

Many drivers come to grief, when turning on a dark road. Misjudging the width of the road, the driver will back the car into a ditch from which the car cannot be removed




**Above, 1, shift lever; 2, bracket; 3, insulation; 4, switch; 5, contact finger; 6, ground; 7, indicates a plan view; 8, the rear light; and 9, battery.**

except with a service car. Also in handling the car at night, for parking, getting out of a parking space, out of the garage and in other close places, the drivers rear view is obscured. Collisions with poles, lamp posts and other cars, do damage not only to the driver's car, but also to others.

An automatic backing light can be made by the mechanically inclined driver, from inexpensive parts, such as is shown in the attached sketch.

A sheet metal bracket is made to fit the cover for the gear shift lever housing. A piece of red fiber or hard rubber is screwed to this. A brass contact finger is shaped so that when the parts are screwed to the

(*Continued on page* 173)

The tendency of plants to grow toward the light is called "phototropism," and the Parrot's Feather shown here markedly exhibits this property.

# Simple Experiments in Botany

## Some Interesting Facts About Plants You Should Know

By RAYMOND B. WAILES

The rise of sap in plants can be clearly demonstrated by slipping a short piece of rubber tubing over the end of a young shoot and inserting a soda straw as shown above.

WE have all heard of the saying that plants breathe. Perhaps our grandmothers have told us that washing the leaves of plants removes the dust and dirt so that they may breathe.

Just how true grandmother's assertion was can readily be determined with some rose or other leaves and a jar of vaseline, grease or lard.

Leaves really do breathe in a sense. Little nostrils if they might be called, or more appropriately, *stoma*, on the underside of the leaves allow the gases of the atmosphere to pass inward and other gases to pass outward. If the little holes are covered with dirt or dust, then the plant literally smothers to death. The little stoma, or valves, are placed by nature on the underside of the leaves so that the dust and dirt cannot readily settle upon them and seal them up.

If some rose leaves are picked and their upper surfaces are smeared with grease, the holes on the underside will not be affected and the water in the leaves will quickly be expelled through the stoma and the leaves will crumple and wither. If a leaf is also picked and its underside or stoma, or breathing side is coated with grease, the little holes will be effectively sealed up, shutting off the escape of water and thus the leaf will remain bright and natural for a much longer time than leaves treated upon their upper surface.

Plants grow toward the light. This property is called phototropism. A saucer of soil sprinkled with some whole mustard seeds and moistened will contain many mustard seedlings in two days of germination in a warm place. If when the seed is sprinkled over the soil, a cup is inverted over the soil and light allowed to enter into the cup only at one point, the sprouted seedlings will be seen to have grown perceptibly toward the light when the cup is removed in the course of two or three days. The seedlings will grow almost horizontally in their effort to seek the light.

A cutting from a rose bush or hedge is placed in ink for an hour and when cut clearly shows that the ink has traversed the stem through the tracheal or sap tubes.

The rise of sap in plants can be clearly demonstrated with a young shoot or stem of a plant. Cut the stem off near the ground and slip a short piece of rubber tubing over its end, then insert a soda straw or glass tube into this rubber tube and immerse the lower end of the glass tube or straw in a glass of water. The efflux of water in the form of vapor, from the leaves, and the ascent of the transpiration stream through the stem will cause water to rise some distance in the glass or paper tube. The force or "pull" of the transpiration stream of a plant is demonstrated and has actually been measured in this manner.

To show that water is really conducted upward through the stem of plants, place a stem cutting in a bottle of ink and allow it to remain for about half an hour. Remove, and with a razor blade or sharp knife cut off the end about an inch or two above the point of immersion. Using a magnifying glass, the ink can be seen to have made several little black marks throughout the stem. The ink in this experiment was really conducted up the tracheal tubes of the stem and the knife cutting across and severing these tubes revealed their presence by the ink which they contained.

How does keeping slips or shoots, or cuttings of plants under a glass jar in the sun keep them warm in the winter? This question has perhaps puzzled many of us. But the glass does, as can be shown by inserting a thermometer inside of a glass jar and comparing its temperature with another thermometer situated outside. The writer, in this experiment found the interior of a glass jar in which a rose slip was taking root had acquired a temperature fourteen degrees higher than that of the outside air. Sunshine and even daylight contains infra-red rays. These rays are commonly called heat rays but they themselves are not hot. But when these infra-red rays strike any objects they produce in the objects the sensation of heat. The glass jars of the gardens allow the infra-red rays to pass through them and when the rays strike the plant or shoot within, the temperature of the plant is raised and the air within is heated, and being protected from wind currents which are found on the outside air, the interior remains warmer than that of the outside. The study of botany is very fascinating.

Mustard seeds are strewn upon moist earth and covered with a teacup. The pencil supports the cup so that daylight from a window can reach the seeds.

In two days, if the cup is removed, the young seedlings which have grown are found to be pointing toward the light which entered through the space made by the pencil.

# MAKING AND USING GARDEN SPRAYS

By DR. ERNEST BADE

THERE are three general classes of sprays used for the protection of garden plants. One controls sap-sucking insects, another the leaf eating kind, while the last which is usually mixed with one or the other of the former types of sprays is used to kill fungus growth on the plant, thus preventing the spread of disease. A single kind of insect spray will not kill all varieties of insects. To be efficient, the type of spray must be adapted to the kind of insect infesting the plant and this can easily be determined by observing the habits of the creature.

The sap-sucking insect pests weaken the plant by introducing their beaks into the tissues of the plant and removing the fluid for their own sustenance. They are usually found on the softer branches and twigs as well as on the leaves, where they may usually be found on the under surface. At times they are found on thicker branches and limbs and even though rarely, on roots. The only type of spray that may be used successfully for their control is some kind of a substance which will clog the breathing pores found on the side of the creatures' body, thus asphyxiating the pest.

The leaf eating forms can readily be recognized by the damage done to the foliage. Here the entire leaf may be devoured or holes eaten into it, while at times, only the main veins of the leaf are left intact, all other parts being eaten. Here the most efficient control is exercised by means of poison in the spray, which coats the leaves with a fine film. As soon as such a leaf is wholly or partially eaten the pest dies.

To prevent the spread of disease fungi a third type of spray is required, but this spray may often be mixed with one or the other of the former types. The varieties of such parasitic plants, for plants they are, is enormous and number among their forms such types as rusts, smuts, mildews and molds, besides a host of others. These destructive parasites depend upon the living plant for food.

In selecting and compounding sprays it is of course essential that the plant be not killed together with the pest infesting it. In this respect it is fortunate that the choice of chemicals fatal to the pest and innocuous to the plant, is quite large, when the chemicals are used in the dilution mentioned under the various formulae.

Copper and sulphur are the two main chemicals used in the checking of disease, and of these the compounds of copper must be handled with care, for too much of

(*Continued on page* 177)

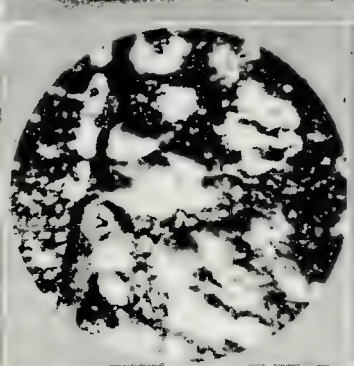
Testing for free copper with potassium ferro cyanide.

Slaking burned lime with water, shown above.

Flowers of sulphur are added to the lime and boiled.

Making a kerosene soap emulsion, shown above.

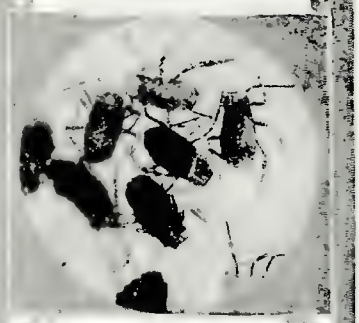
Above—making a small quantity of lead arsenate.



Scale insects on underside of leaf.

A fungus disease on a bean plant is shown above.

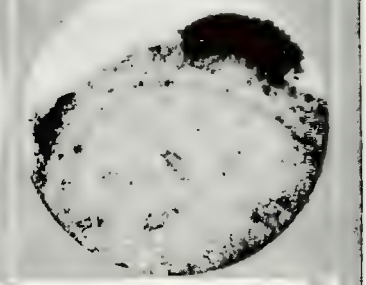
Above is a photo of a flying aphis.



Photograph of an aphis colony on a leaf.

Mildew on gooseberry enlarged 200 times.

Fusicladium, a disease which splits the pear.



Cross-section through asparagus stem, showing fungi spores.

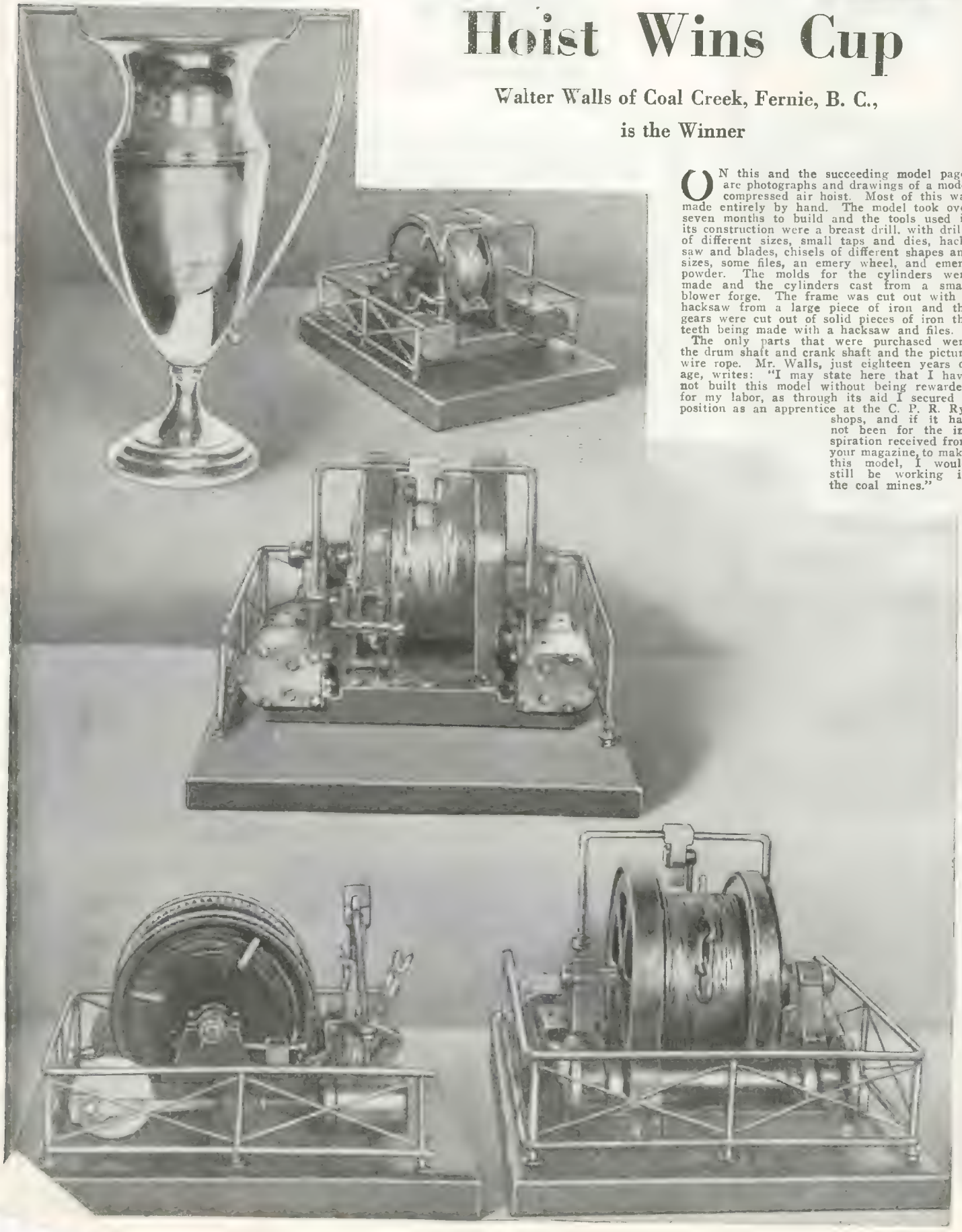
# Model Department

## Hoist Wins Cup

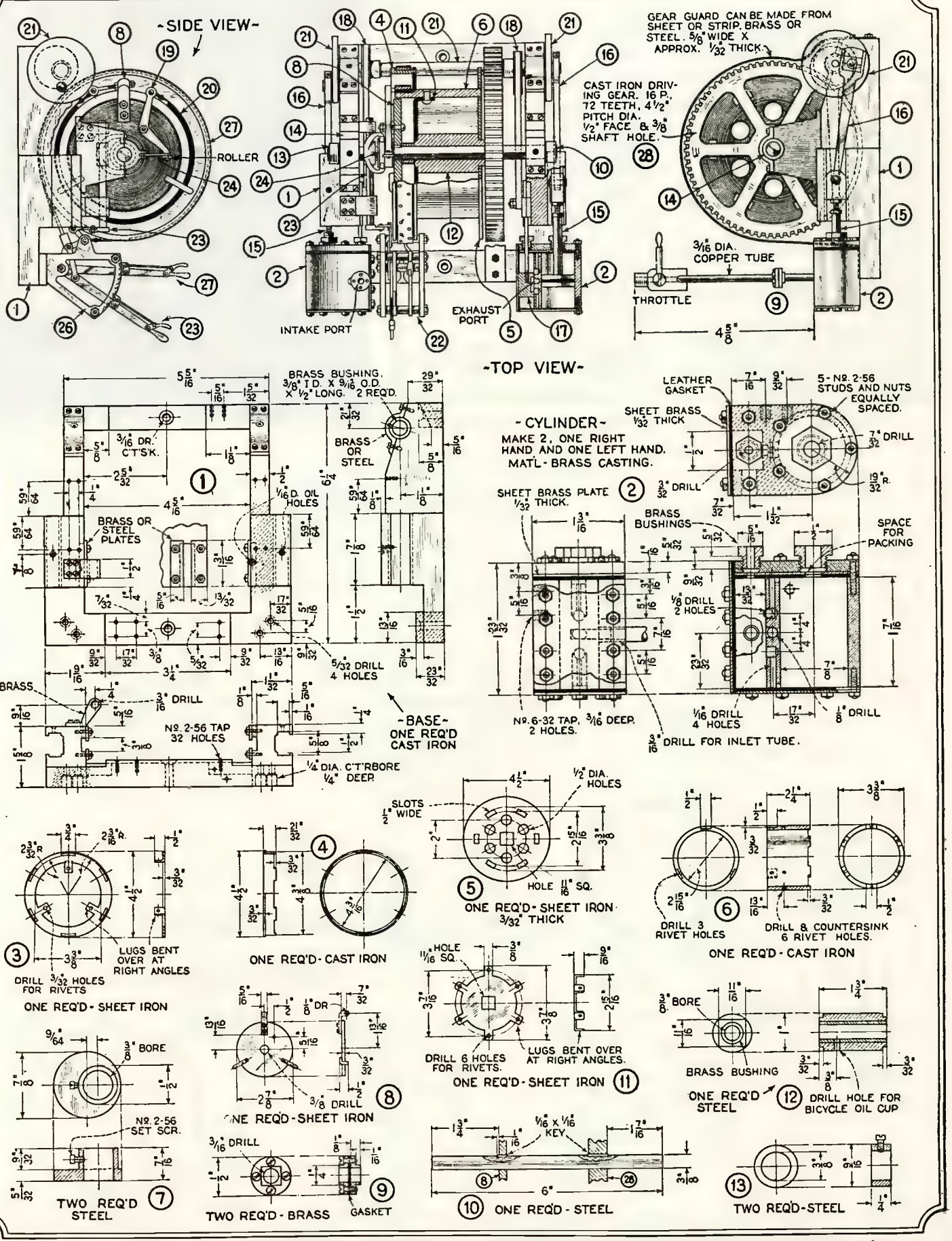
### Walter Walls of Coal Creek, Fernie, B. C., is the Winner

ON this and the succeeding model pages are photographs and drawings of a model compressed air hoist. Most of this was made entirely by hand. The model took over seven months to build and the tools used in its construction were a breast drill, with drills of different sizes, small taps and dies, hacksaw and blades, chisels of different shapes and sizes, some files, an emery wheel, and emery powder. The molds for the cylinders were made and the cylinders cast from a small blower forge. The frame was cut out with a hacksaw from a large piece of iron and the gears were cut out of solid pieces of iron the teeth being made with a hacksaw and files.

The only parts that were purchased were the drum shaft and crank shaft and the picture wire rope. Mr. Walls, just eighteen years of age, writes: "I may state here that I have not built this model without being rewarded for my labor, as through its aid I secured a position as an apprentice at the C. P. R. Ry. shops, and if it had not been for the inspiration received from your magazine, to make this model, I would still be working in the coal mines."



# Details of Prize Winner

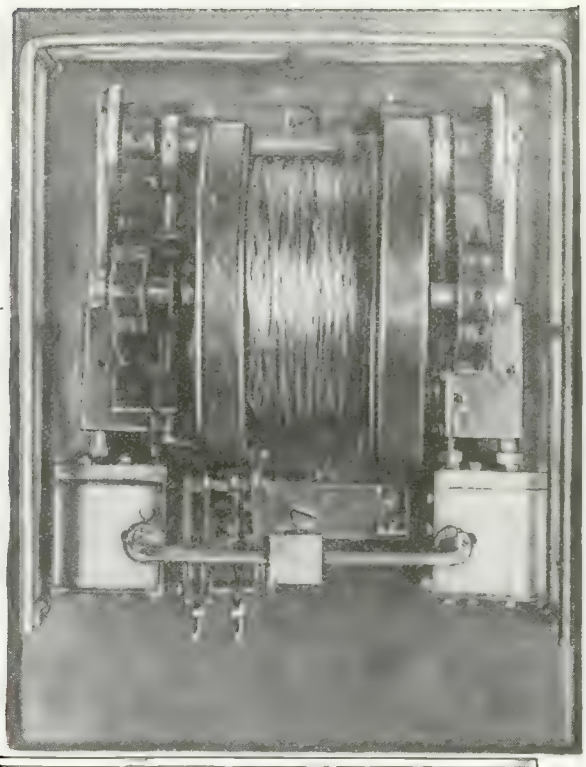

-SIDE VIEW-
ROLLER
INTAKE PORT
EXHAUST PORT
-TOP VIEW-
GEAR GUARD CAN BE MADE FROM SHEET OR STRIP, BRASS OR STEEL. 5/8" WIDE X APPROX. 1/32" THICK.
CAST IRON DRIVING GEAR. 16 P., 72 TEETH, 4 1/2" PITCH DIA. 1/2" FACE & 3/8" SHAFT HOLE.
3/16 DIA. COPPER TUBE
THROTTLE
4 5/8"
BRASS BUSHING. 3/8" I.D. X 9/16" O.D. X 1/2" LONG. 2 REQD.
BRASS OR STEEL
3/16 DR. C'T'SK.
BRASS OR STEEL PLATES
1/16 D. OIL HOLES
5/32 DRILL 4 HOLES
BRASS
3/16" DRILL
NO. 2-56 TAP 32 HOLES
1/4 DIA. C'T'RBORE 1/4" DEEP
-BASE- ONE REQ'D CAST IRON
-CYLINDER-
MAKE 2, ONE RIGHT HAND AND ONE LEFT HAND. MAT'L - BRASS CASTING.
LEATHER GASKET
SHEET BRASS 1/32 THICK
5 - NO. 2-56 STUDS AND NUTS EQUALLY SPACED.
7/32" DRILL
3/32" DRILL
19/32" R.
SHEET BRASS PLATE 1/32 THICK.
BRASS BUSHINGS
SPACE FOR PACKING
1/8" DRILL 2 HOLES
NO. 6-32 TAP, 3/16 DEEP. 2 HOLES.
1/16 DRILL 4 HOLES
1/8" DRILL
3/16" DRILL FOR INLET TUBE.
ONE REQ'D - SHEET IRON
LUGS BENT OVER AT RIGHT ANGLES
DRILL 3/32 HOLES FOR RIVETS
ONE REQ'D - CAST IRON
SLOTS 1/2" WIDE
1/2" DIA. HOLES
HOLE 11/16" SQ.
ONE REQ'D - SHEET IRON 3/32" THICK
DRILL 3 RIVET HOLES
DRILL & COUNTERSINK 6 RIVET HOLES.
ONE REQ'D - CAST IRON
3/8" BORE
NO. 2-56 SET SCR.
TWO REQ'D STEEL
3/8" DRILL
ONE REQ'D - SHEET IRON
HOLE 11/16 SQ.
DRILL 6 HOLES FOR RIVETS.
LUGS BENT OVER AT RIGHT ANGLES.
ONE REQ'D - SHEET IRON
BRASS BUSHING
ONE REQ'D STEEL
DRILL HOLE FOR BICYCLE OIL CUP
3/16 DRILL
TWO REQ'D - BRASS
GASKET
1/16 X 1/16 KEY
6"
ONE REQ'D - STEEL
TWO REQ'D - STEEL

The above drawings indicate the assemblage and details of the prize-winning model for this month. Further details appear on the following page. While the original model was made entirely by hand, the details here given enable the model builder to duplicate the model, using such equipment as can be purchased at any large hardware supply store. The rules for the Model Contest appear on the following page, so if you have not entered a model in this contest, get busy now.

# Steam Winch

(*Continued from previous page*)

**At the right we have a top view of a steam winch which won the cup in this month's contest, and below are concluded the details for the construction of a model of this nature. For the benefit of those who do not know about this Model Contest, the rules are republished below.**



## RULES FOR MODEL CONTEST

1. A handsome trophy cup engraved with your name, will be awarded as the prize for the best model submitted during the month. The decision of the judges will be final and will be based on: A—novelty of construction; B—workmanship; C—operating efficiency of the model as related to the efficiency of the device which the model simulates, and D—the care exercised in design and in submitting to us sketches and other details covering the model.

2. Models of all kinds may be entered. They may be working models or not, according to the subject that is being handled.

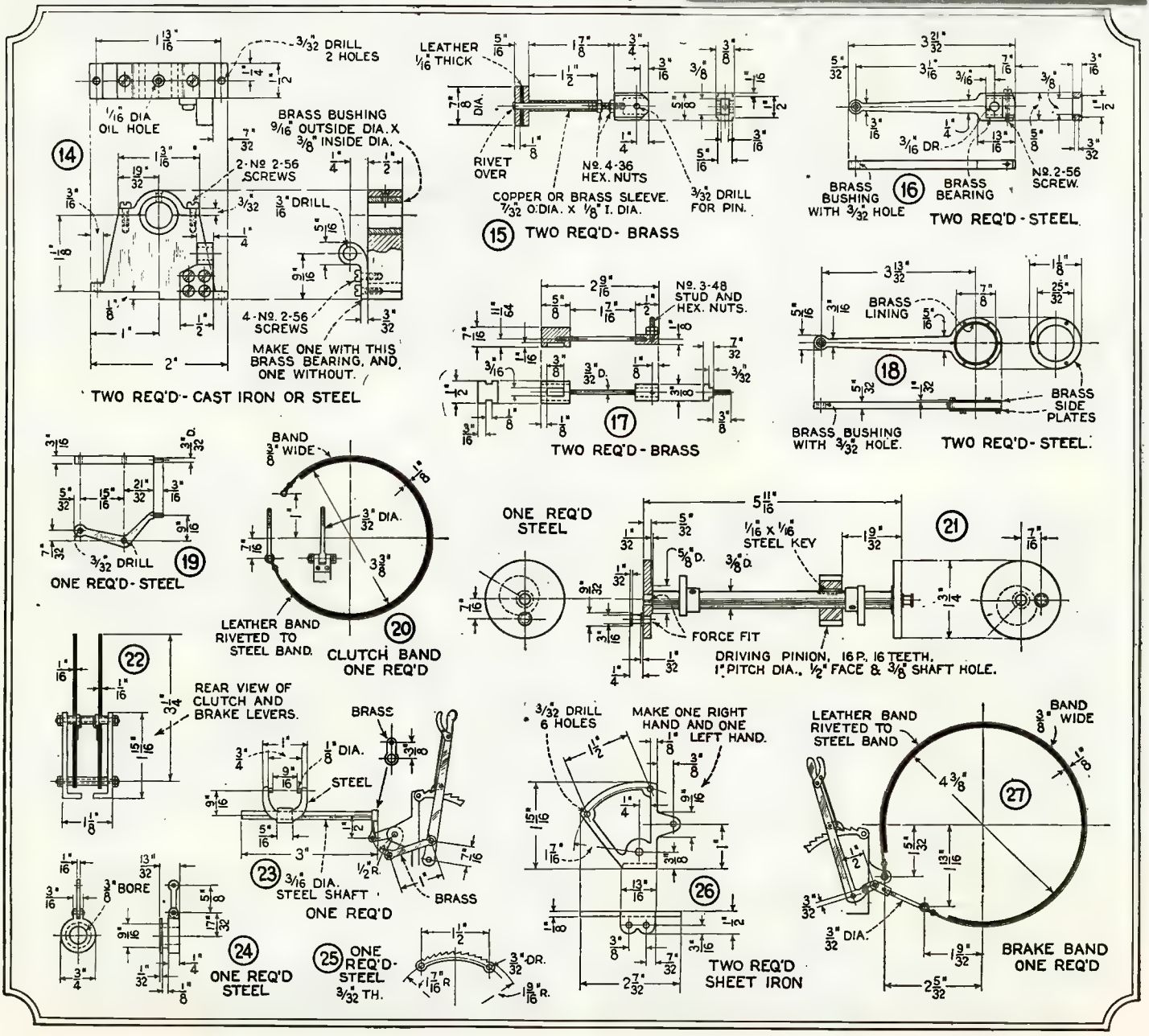
3. Models may be made of any available material, preferably something that is cheap and easily obtainable.

4. Models must be submitted in all cases. Good photographs are also highly desirable and where the maker does not desire the model to be taken apart, legible drawings with all dimensions covering parts that are not accessible must be submitted.

5. Models should be securely crated and protected against drainage in shipment and sent to us by parcel post, express or freight prepaid. Models will be returned when requested.

6. Models for entry in any particular contest must reach this office on or before the 25th of the third month preceding date of publication. For instance, models for the August contest must reach us on or before the 25th of May.

7. Address all entries to Editor Model Department, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.



# Double-Dovetail Cabinet Joints

By I. E. LOVETT

THIS is the strongest dovetail joint which can be made; and is an ideal method of fastening together the sides of any box for ornamental or useful purposes.

It is a joint which cannot come apart in any way, if carefully carried out, and a glued block used in the internal angle of the box, or a bottom board glued down is still better. It looks a very mysterious joint, and at the first glance seems impossible to put together.

The idea of the glued block is to hide the inner cutting which allows the dovetail to be driven into position, and it is also to prevent the dovetail from coming out the way it was put in.

With the bottom in position the dovetail cannot be loosened, to allow it to catch or in any way to change its shape, so that, practically speaking, it is as firm and rigid as the solid material; and without the use of glue in the dovetails themselves, or the disfigurement of nails this freak dovetail is quite useful.

Although at first glance it appears a little complicated, it is really quite simple, and is a very attractive joint.

In making up boxes of this type a good plan in planing up the material is to get the sides and ends in one long strip, the breadth being the combined depth of the box and the part of the sides which is fixed to the lid. This allows the two frames which form the sides of box and top to be dovetailed together at the same time; and then, when the top and bottom boards are glued on, a saw cut separates the two parts ready for planing and fitting for the hinges.

The drawings of the dovetails are shown with that idea of carrying out the work, and the position of the saw cut is marked.

A box of this pattern would be best made of good working wood, mahogany, walnut, or teak.

The wood must be sound and well seasoned and should be ½ inch thick to begin with.

The dimensions may vary in such an article according to the individual requirements, but the size suggested is an average one, and should be found generally serviceable.

(*Continued on page* 170)

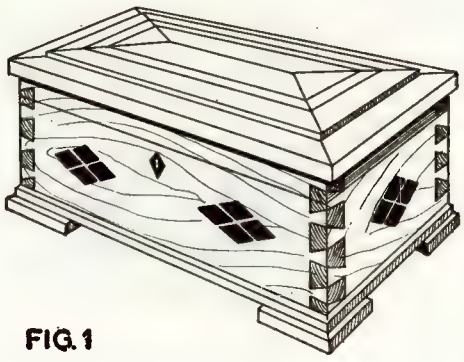


FIG. 1

**The double dovetailed joint represents one of the finest examples of the cabinet builders' art. Very few people know how this mystifying joint is put together. Every wood-worker at some time in his career aspires to build a cabinet with double dovetail joints in it. The author gives here the method of making this unusual and at the same time extremely artistic wood joint.**

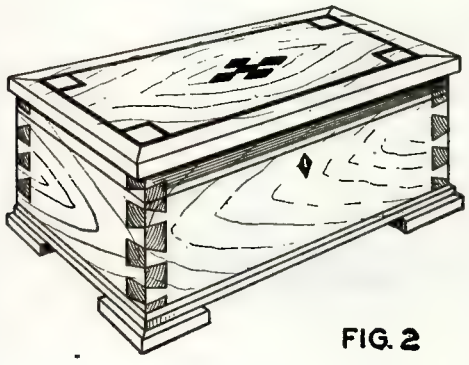


FIG. 2

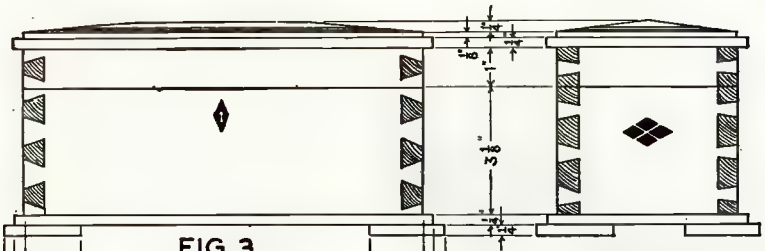


FIG. 3

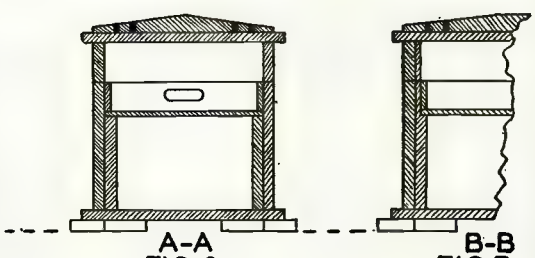


FIG. 5



A-A
FIG. 6



B-B
FIG. 7

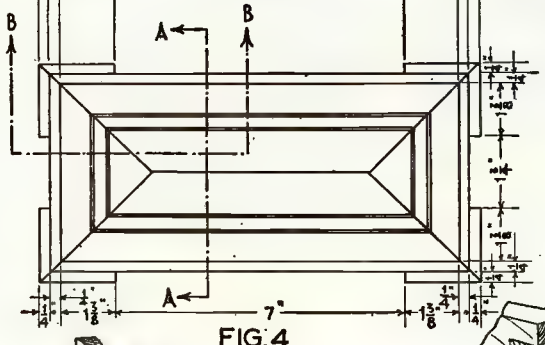



FIG. 4

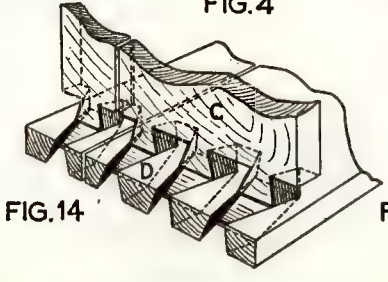



FIG. 14

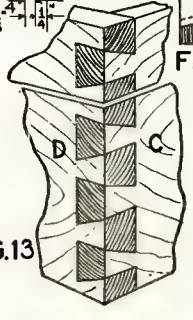



FIG. 13

FIG. 9

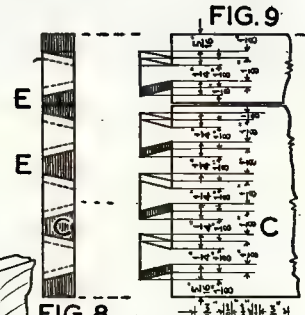



FIG. 8

FIG. 11

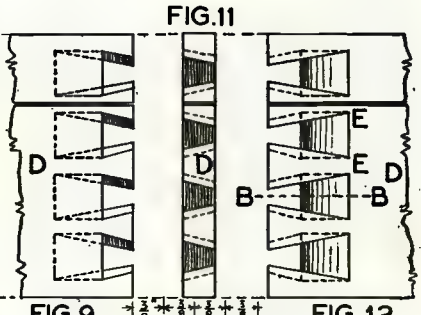



FIG. 9 FIG. 12

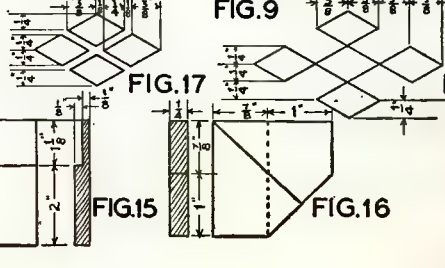


FIG. 17 FIG. 18

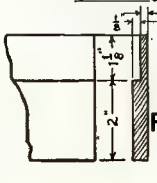


FIG. 15



FIG. 16

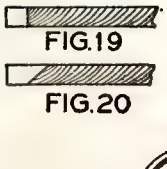


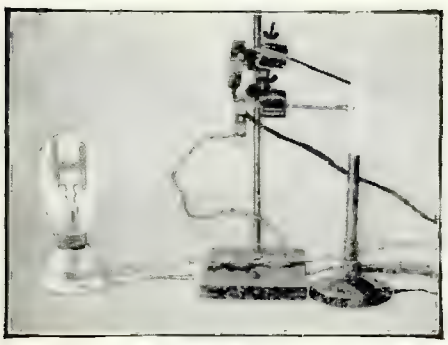
FIG. 19 FIG. 20

EXPERIMENTAL Chemistry and Electrics

# Experimenting With Neon Lamps

By RAYMOND B. WAILES

THE majority of electrical experimenters have, no doubt, toyed with and played around burnt out and also perfectly good electric light bulbs, just to see what stunts or uses to which they could be put. And the experiments usually wound up by sticking them on the



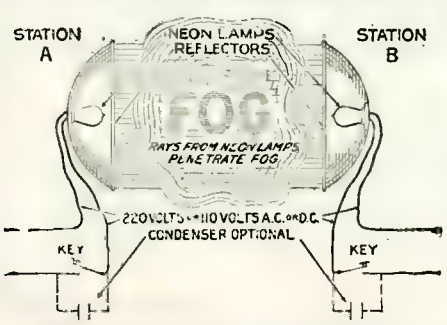
**Electro-conductivity of metallic vapors is demonstrated in this experiment with a neon light.**

secondary side of a spark coil, breaking off their tips while under water, or "busting" the glass to use the filaments for cats-whiskers.

The neon lamp will provide many interesting hours of scientific fun and knowledge to the experimenter, as the following experiments will show.

A neon lamp is a filamentless electric lamp containing two electrodes separated from each other by a small space or interval and filled by neon gas. Many of the lamps operate on 220 volts, but the writer has used 2-watt, 110-volt lamp in most of his experiments. They can be had from advertisers in *this journal.*

The characteristic pinkish glow of the neon discharge can be seen when a neon lamp is connected across the secondary terminals of a spark coil. A high voltage producing this glow would lead one to the conclusion that a neon lamp could serve as a detector of high voltages. Such is the case, for pencil-shaped tubes of neon gas are being used to test the ignition system of automobiles. An ordinary lamp socket having its two binding screws connected together with wire and the wire led out through the wire




**A night "blinker" set using neon lamps for signaling by dot and dash code.**

outlet hole serves as a good line detector for voltages over 110. When a neon lamp is screwed into the socket and the socket wire brought near a current-carrying wire the lamp will glow.

The press has lately been heralding a neon lamp to be used as a guide mark in aerial navigation. A little neon lamp blinker set for night signalling can be rigged up by the experimenter and messages carried on between stations in darkness. An ordinary telegraph key is connected in series with the neon lamp mounted in a reflector or lamp shade, and the source of current. It will be found that the pinkish beam from the lamp can be seen through fog. A condenser shunted across the contact points to reduce sparking is unnecessary, for the lamp draws such a minute quantity of current that this protection is needless. There is not a time lag in a neon lamp, which is very unlike an incandescent lamp in this respect, whose filament heats up rather slowly and cools down still more slowly. On making contact at the key with a neon lamp in circuit, the lamp lights and when the key is released the glow ceases, not gradually, but instantly. Then, too, if there is resistance at the key points an electric lamp will glow dimly. A

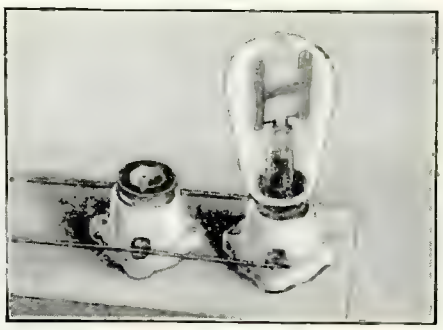
**A handy tester for "live" wires made from a neon lamp.**

neon lamp will not light at all under these conditions.

The light from a neon lamp is non actinic, therefore it can be used for photographic purposes in a dark room.

One of the photographs shows a neon lamp shunted across a fuse. The fuse is in an electric circuit, which, if overloaded, will cause the fuse to be blown. When this condition is reached, the neon lamp will light, and not before, so here, the neon lamp is acting as a signal device to indicate that the particular fuse across which it is shunted has been blown. The reason for this is simple. The fuse has comparatively no resistance and, therefore, when shunted across a lamp having a very high resistance, the lamp will not get any current or will not light. But when the fuse is blown, the current passes through the lamp, causing it to glow.

A very interesting experiment shows the conductivity of metallic vapors. Two copper wires are thrust through corks and the corks are held in clamps upon a laboratory support as shown in one of the photographs. Connections are made with the 110-volt circuit, so that when the two bare copper wires are touched together a neon lamp included

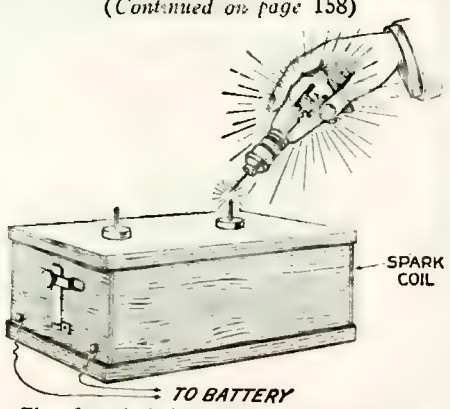


**When the fuse shown here blows, the neon lamp lights, indicating the fact.**

in the circuit will light. The wires were then mounted one above the other and about a sixteenth of an inch apart. When copper salts, such as copper chloride, are placed on the lower wire, and a Bunsen flame applied there, the salt will decompose and vaporize, producing a green flame, which is due to metallic copper vapors. As this metallic vapor flows up to the upper copper wire it serves as a metallic path which conducts the current across the space between the wires, thus lighting the lamp. This experiment brings to mind the historic experiment of flame-conductivity — possibly unilateral conductivity—in which wires and a Bunsen burner arranged as shown were connected to an aerial and ground, also being shunted by a circuit consisting of a pair of head phones and several dry cells. The whole set-up being capable, it has been said, of being able to receive radio signals. This the writer never has been able to make work.

One noted use of a neon lamp is its ability to flash when a certain potential is ap-

(*Continued on page* 158)




**The characteristic glow of neon gas can be shown by touching one terminal of a neon lamp to a spark coil high voltage terminal.**

# Of What Cloth Is Your Suit Made?

## The Chemistry of Textiles Explained for the Layman

By EDNA R. HAMBURGER, Ph.D.

HAVE you ever stopped to realize that the cotton plant which is providing the materials, the blouse which you are wearing, also provided the materials which clothed countless ancestors, or that the use of linen in the western world, or of silk in the orient, dates back to the dawn of history. And yet one would scarcely state that, allowing for the differences in style, the materials from which clothing is manufactured are identical with those used by his grand-parents.

### WHY CLOTHS DIFFER

TO what is this difference due? To a variety of causes, each dependent upon the increased scientific knowledge of the substances in question. For example, by subjecting the cotton, wool or silk to different chemical processes, or by blending them in various ways their surface appearance is so changed that a new fabric has apparently been produced. But the art of the chemist has gone a step further—he has actually synthesized in the laboratory an artificial silk called rayon, which is now adding a fifth basic fiber to our dress materials.

Perhaps you have just admired that beautiful piece of silk, never realizing that it may be a combination of real silk with rayon. Or again you may have wondered why a certain manufacturer could afford to offer a suit of clothes at such a ridiculously low price. The answer is probably that the fabric is a clever mixture of cotton and wool. But how can you tell the true nature of a material, my reader may ask. By experiments his scientific mind will answer. And the chemist has worked out a scheme whereby he can recognize the characteristics of each fiber in a given piece of material, with a reasonable degree of accuracy and ease.

### TESTS FOR COTTON AND LINEN

THE first thing he did was to study the behavior of each fiber separately. Suppose you take a thread of cotton. Burn the thread by applying a match. It will burn rapidly. You will notice that it will leave a light fluffy ash of no definite form or shape. If you have a very keen sense of smell you will observe the characteristic odor of burning paper. This odor is better obtained by burning a larger quantity in a dry test tube. Hold a piece of wet litmus paper in the mouth of the tube so that the vapors will touch the paper. After a few minutes blue litmus paper will turn pink; pink litmus paper remains unchanged. Evidently an acid is given off in the vapors. Repeat this experiment with linen. The same results will be obtained.

### FLAME TEST FOR WOOL

SUPPOSE you now burn a few threads of wool. Immediately the disagreeable odor of burning flesh or feathers will be noticed, accompanied occasionally by a slight odor of ammonia. The thread will take a longer time to burn. Instead of a light fluffy ash, a round, gummy ball will be obtained. If some of the wool is heated in a test tube and tested with moist litmus paper, as in the case of cotton and linen, it will be found that the blue litmus paper will remain unaffected, while the pink will change to blue. Evidently a base is given off. The odor tells us that this basic reaction is due to ammonia (ammonia plus the water of the litmus paper form ammonium hydroxide which turns the pink litmus paper blue.) Repeat the procedure with silk. The silk thread will take less time to burn than the wool, but the same gummy, ball-like ash is obtained. If, however, the silk is heavily weighted, by chemicals introduced by the manufacturer, the ash will retain the original shape of the thread instead of giving the characteristic round ash. As with wool, moist pink litmus paper is turned blue, and the odor of ammonia is pronounced.

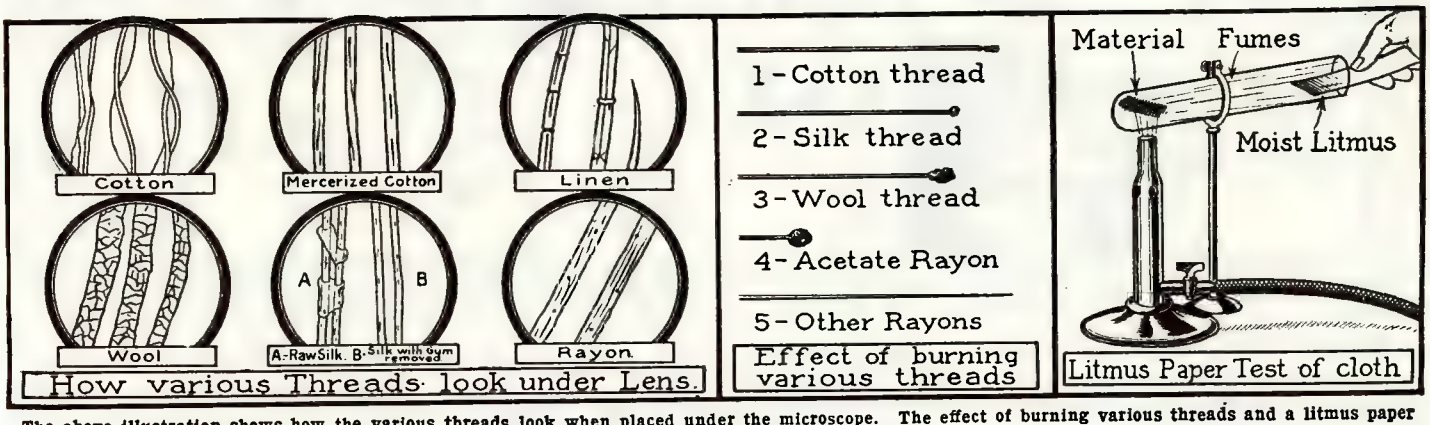
### COTTON AND SILK FIBERS CHEMICALLY DIFFERENT

EVIDENTLY there is a distinct chemical difference between cotton and linen on the one hand, and silk and wool on the other. Further chemical analysis confirms this fact and tells us that cotton and linen are both essentially cellulose, a compound consisting of carbon, hydrogen, and oxygen only. Wool and silk prove to be proteins, compounds containing nitrogen, carbon, hydrogen, and oxygen. Some proteins are known to contain sulphur. To see whether sulphur is present in the proteins of either silk or wool hold a piece of moist lead acetate paper (lead acetate paper is filter paper dipped in a solution of basic lead acetate) in the fumes obtained upon burning. A dark brown or black coloration, due to the formation of lead sulphide indicates the presence of sulphur. The fumes from wool will turn the paper black, indicating the presence of sulphur compounds; those from silk have no such effect. Silk and wool, therefore, contain proteins which are different chemically.

### RAYON—HOW TO TEST FOR PRESENCE OF

How does rayon act upon burning? Since it is primarily a cellulose product, chemical reasoning tells us that it should resemble cotton and linen in action. And it does. The odor given off is that of burning wood or paper. Moist blue litmus held in the fumes turns pink. The same fluffy ash is obtained. The only difference is in the speed of burning. Rayon burns at a much faster rate than cotton.

There is one kind of rayon which acts differently, however. As my reader may know, there are four possible ways by which to make rayon, resulting in products commonly known as viscose, nitro-cellulose, cuprammonium, and cellulose acetate silks. The first three are more or less similar, and as a group act somewhat differently from the cellulose acetate silks, not only when burnt, but in many other chemical reactions. If a thread of cellulose acetate is burnt, it rolls up so that the ash is a tiny ball, quite brittle when cold. The silk seems to melt just before it burns, a tiny sputtering mass preceding the flame. I once tested a piece of rayon satin which seemed to roll up just like a kitten, when I applied the flame of a match.




**The above illustration shows how the various threads look when placed under the microscope. The effect of burning various threads and a litmus paper test of cloth are also illustrated.**

### SIMPLE CHEMISTRY OF CLOTH DIAGNOSIS

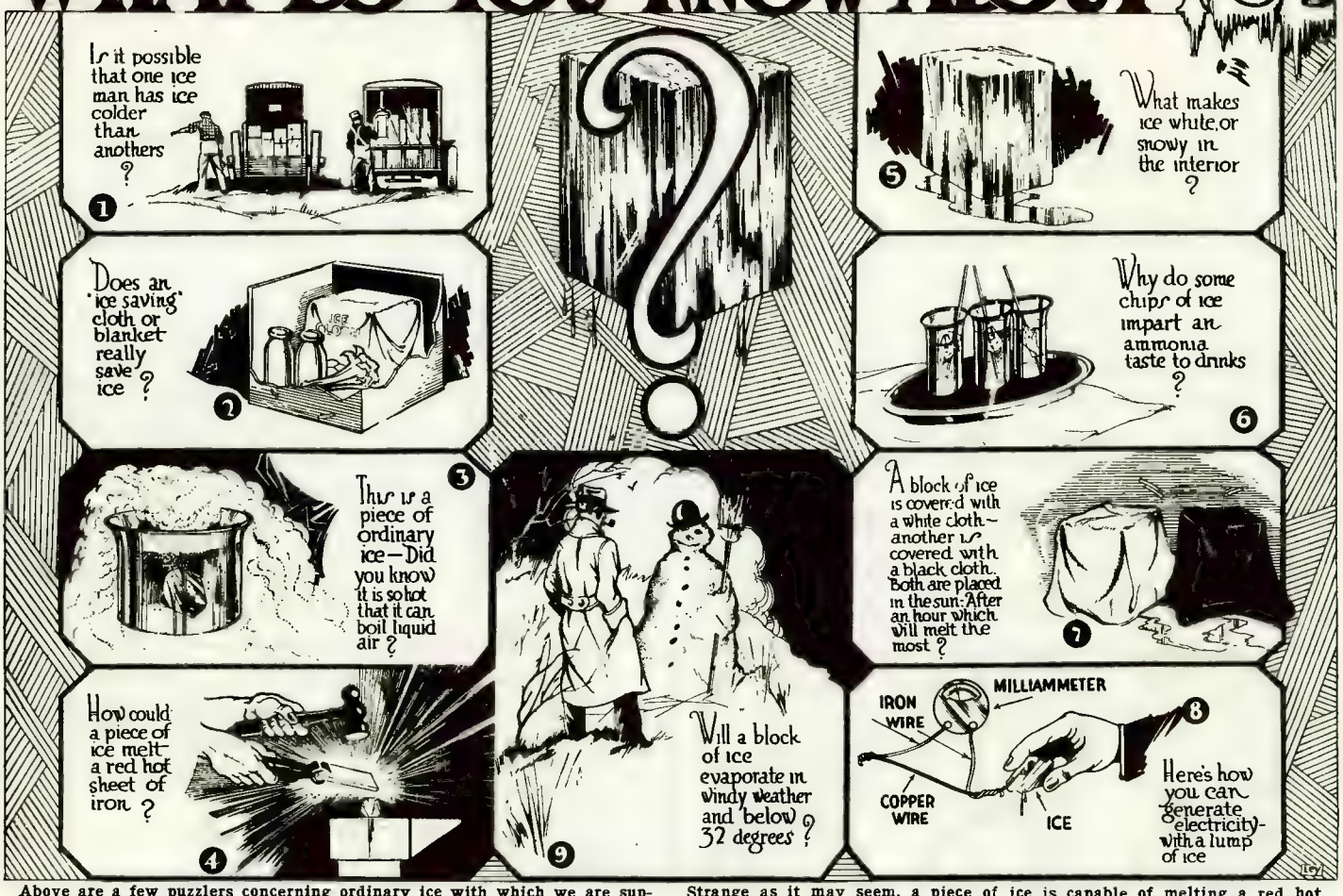
HAVING gained an insight into the nature of the fabric by means of this simple burning test, the chemist can proceed further with its identification. Suppose wool is indicated. Prepare a 5% solution of sodium hydroxide (caustic soda). Babbit's lye will answer the same purpose. One tablespoonful dissolved in a pint of water will give approximately a 5% solution. Immerse the fiber in the solution and heat to boiling. Pure wool will dissolve completely. So will silk. Cotton and linen are not affected by the alkali. Rayon will probably gelatinize, i.e., swell into a jelly-like mass. A 10% solution of sodium hydroxide is often used to identify rayon, since this is the only fiber which will gelatinize immediately upon being immersed in the cold solution.

### WHEN SILK IS INDICATED

SUPPOSE instead of wool, silk had been indicated. Cover the fiber with concentrated hydrochloric acid (muriatic acid). Within two minutes pure silk will dissolve completely. Again no other textile material reacts in just this fashion. Perhaps my reader is unable to obtain concentrated hydrochloric acid. Another reagent which will dissolve silk in almost every instance is copper glycerol solution. To prepare the latter, dissolve 16 grams of copper sulphate

(*Continued on page* 161)

# WHAT DO YOU KNOW ABOUT ICE


Is it possible that one ice man has ice colder than another's ?
1
Does an ice saving cloth or blanket really save ice ?
2
This is a piece of ordinary ice—Did you know it is so hot that it can boil liquid air ?
3
How could a piece of ice melt a red hot sheet of iron ?
4
Will a block of ice evaporate in windy weather and below 32 degrees ?
9
What makes ice white or snowy in the interior ?
5
Why do some chips of ice impart an ammonia taste to drinks ?
6
A block of ice is covered with a white cloth—another is covered with a black cloth. Both are placed in the sun. After an hour which will melt the most ?
7
MILLIAMMETER
IRON WIRE
COPPER WIRE
ICE
8
Here's how you can generate electricity with a lump of ice

**Above are a few puzzlers concerning ordinary ice with which we are supposed to be well acquainted. How many of these questions can you answer correctly? The correct answers will be found in the text below.**

**Strange as it may seem, a piece of ice is capable of melting a red hot sheet of iron or steel under certain conditions. Stranger yet is the fact that ordinary ice is so hot that it will cause liquid air to boil.**

## ANSWERS TO QUESTIONS

(1) One iceman can have colder ice than the other. Take heat away from water until the temperature reaches 32° F. and the water will become solid. If heat is still taken away from it, ice at lower temperatures will result.

(2) An ice saving cloth or blanket will save ice, but at the same time it prevents the foods from becoming chilled as easily as they would if the blanket were left off.

(3) All frozen substances contain heat, even if they are cold to the touch. The ones having less heat are colder than others. Ice can have a temperature of 30°F. and frozen alcohol a temperature of minus 100° F.

When both are placed together, the heat from the ice will melt the alcohol and cause it to boil. The same is true in the case of liquid air.

(4) A red hot piece of iron, if placed about a half inch above a piece of ice, when given a vigorous blow will descend and crush the ice, causing it to change into water, then into hydrogen and oxygen gas, which will explode and very often melt the piece of iron.

(5) Bubbles of air which remain in the water while the ice is freezing cause snow-ice to form.

(6) Leaky ammonia pipes might cause the ice to taste like ammonia; the ammonia gas escaping into the air dissolving into the water.

(7) Light colored objects reflect the heat waves while dark ones absorb them. The ice covered with a dark cloth will melt faster.

(8) If one of the twisted wires is made colder than the other, a minute current of electricity will flow through the wire.

(9) Yes, ice will evaporate even though water will freeze beside it.—*R. B. Wailes.*

**Skunk scent consists of mercaptan, a so-called sulphur alcohol, which is the family name for a host of evil-smelling substances, well known to the chemists.**

# Curiosities of Chemistry

The vile odor of the skunk is due to a fluid which is secreted by two glands and which may be ejected to a distance of 15 feet as a protection means. This liquid causes acute distress when it comes in contact with the mucus membrane. Skunk scent consists of mercaptan, a so-called sulphur alcohol which is the family name for a host of evil-smelling substances. Mercaptans are organic compounds of carbon, hydrogen and sulphur. They are the sulphur analogues of the alcohols and phenols. The organic hydrosulphides are usually called mercaptans.

Hair-plastering liquids have paraffin oil as a basis. Paraffin oil is obtained as one of the products of distillation from crude petroleum which consists essentially of mixtures of many different hydrocarbons, which are compounds containing only the elements hydrogen and carbon. Paraffin is separated from a fraction of one of the petroleum distillates by artificial chilling.—*R. B. Wailes.*

## WHAT ARE THE "HAIR STAY BACK DRESSINGS" MADE OF ?

**Paraffin oil, from crude petroleum, is the basis for the hair-plastering liquids now on the market. It costs about thirty cents a gallon.**

# Pictures in Silhouette

By DR. ERNEST BADE

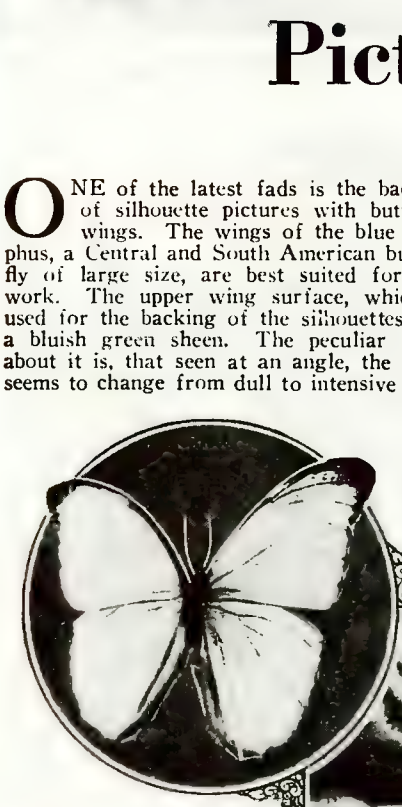
ONE of the latest fads is the backing of silhouette pictures with butterfly wings. The wings of the blue morphus, a Central and South American butterfly of large size, are best suited for this work. The upper wing surface, which is used for the backing of the silhouettes, has a bluish green sheen. The peculiar thing about it is, that seen at an angle, the color seems to change from dull to intensive blue, and as the angle of vision is changed, the background of the silhouette changes in tone and intensity of color.

This metallic sheen is extremely valuable for the purpose of background work, since it has the color of the sky or of water, the entire picture with its silhouette and background of blue gives the effect of a night picture, a picture that is alive, due to the changing shades of the blue background.

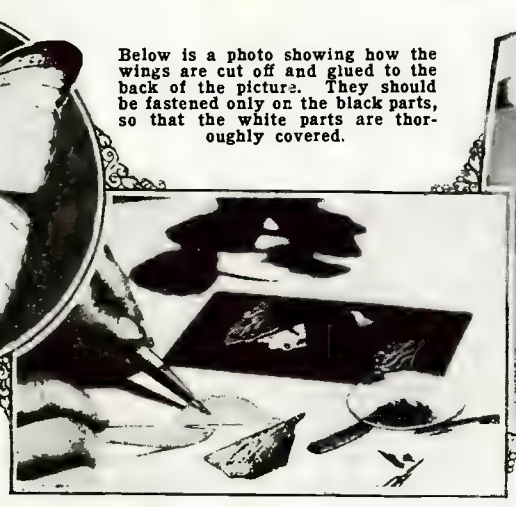
Great care must be exercised in handling the wings; the front should never be touched; the back may, for its color is drab gray or brown with larger brown markings. The entire structure is exceedingly delicate, while the surface itself is dust-like in character, and may easily be rubbed off and leaves nothing but a transparent membrane.

The silhouettes may be cut from black paper or, which is better, they may be photographed on glass plates. Then the wings are cut from the butterfly and glued to the gelatine side of the glass plate by means of shellac varnish, using minute traces of the shellac and placing it on the silhouette, not on the white spots. Smaller pieces may be used, these being glued to the wing surfaces already in place. When the entire white spots have been covered, the glass plate is placed in a frame, first covering the edges with a white piece of cardboard to set off the picture. When this has been done, another piece of cardboard is fastened on the back of the plate. This holds the wings on the silhouette against the glass and also prevents them from being accidentally damaged. Many beautiful pictures can be made by using the above method of silhouetting the pictures against a background of butterfly wings. The first efforts will, of course, be rather crude, and undoubtedly many wings will be spoiled before successful pictures are obtained.

Your patience will be rewarded by the results.



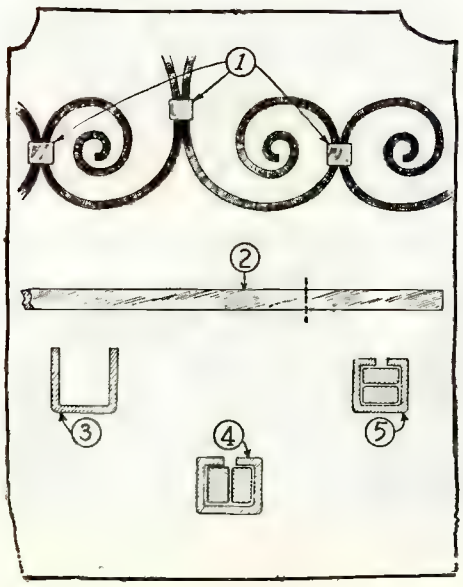
**Above is the blue morphus, the butterfly used in the backing of the silhouette pictures.**



**Below is a photo showing how the wings are cut off and glued to the back of the picture. They should be fastened only on the black parts, so that the white parts are thoroughly covered.**

**Above—The back of the picture.**

**A front view of one of the finished silhouette pictures appears above. A most pleasing effect is obtained with the white mask and frame in place. The metallic sheen given by the wings of the butterfly is particularly valuable for the purpose of background work. Furthermore, when viewed at different angles, the color seems to change from a dull to an intensive blue.**

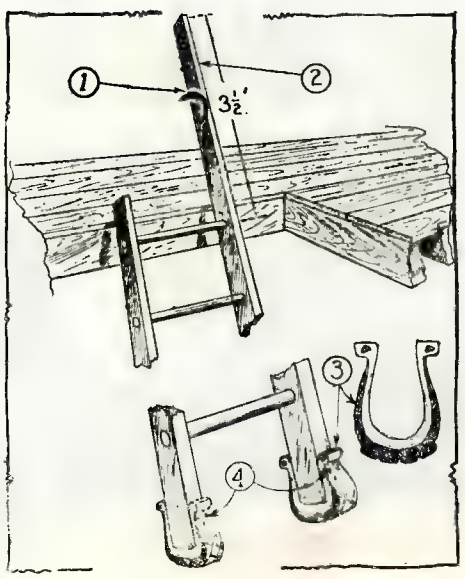



## IRON GRILLE CLIPS

To hold venetian iron work together, small rivets are generally used at the juncture of the scrolls, frames and other parts of contact. In order to save all the labor incident to drilling, fitting in the rivets and driving over the metal, clips made of the same material can be bent with pliers and forced over the work. These clips can be cut from the same soft iron as the body of the work. 1 shows the clips in place, 2 the iron bar from which they are cut, 3 shows a clip, and 4 and 5 the clips in use.—*G. A. Luers.*

## SAFETY LADDER

By referring to the sketch at the right, one will see a ladder that is much safer than the average types. It is fitted with pieces of tire at the feet, to prevent slippage even on a highly-polished floor. The one side is extended about 3½ feet, so that the climber will have a hand hold for stepping off or getting on the ladder.—*G. A. Luers.*



Prying off metal tip before cutting roller. Two sticks can be used to measure width of window. Cutting the roller to fit the window. Driving the tip into end of roller.

# Fitting Window Shades

By L. B. ROBBINS

TO properly fit a window shade requires an observance of certain rules and procedure so the shade will hang properly, run easily and stay at the height desired. Moreover it must make a neat appearance whether up or down, its edges must be clean and true and it must fully cover the window to be of real use.

As a mater of illustration let us take an ordinary shade and fit and hang it according to the proper methods. These can be followed intelligently by looking at the accompanying photographs as the text is read. Each essential point is taken up in order and, with a few essential tools, anyone should be able to hang a shade properly with but little trouble after these directions have been thoroughly absorbed.

The first point to consider is whether the shade is to be hung inside the window casing or outside. Just how the drapes and curtains are to be arranged will be a factor in determining this. If flouncy and fancy curtains are to cover the window trim then it will be best to place the shade inside the window casing so it will come down clear of the curtains. If the window trimmings are simple and plain and the shade will not be liable to catch in frills and meshwork then they can be hung on window trim and thus better cover the window opening. What ever is done will largely be a matter of choice and convenience with the one doing the decorating.

Now act's measure the window for the shade. If the roller is to hang inside the casing great care must be taken with the measuring. If a yardstick or rule will not conveniently reach across the opening then take two slender sticks and lap the ends. Place them inside the casing and gradually slide them along until the outer end of each touches the casing. Then gently remove them, holding them tightly together all the while and measure their combined length. This will be the exact distance between sides of the casing. This will also be the exact length of the shade roller to the *ends of the metal tips.*

Now if the shade is to fit over the outside of the casing different allowances should be made. Figure to cut the roller so it will lap a half inch over the edge of the casing each side. This means it should be cut 1 inch longer than the width of the window opening irrespective of the metal tips.

Fasten the brackets in position on or inside the casing with the screws or nails accompanying them. On the outside of the casing put them, of course, half an inch back of each edge and about the same distance above the top edge. When placing for an inside roller simply fasten them against the inside of the casing and far enough down from the top so the rolled up shade will just clear the top. Always place the slotted bracket at the left and the bracket with the hole at the right.

To cut the roller to fit, first unroll the shade and remove the tacks holding it to the roller. Then with a screwdriver or similar tool pry up the plain round tip and remove it from the end of the roller. Measure the required length from the edge of the ferruled end and then saw the roller off square at that point. Punch a small hole in the exact center then drive in the tip with a hammer. The roller should now be the proper length and make a snug but rolling fit in the brackets. It might be added that to get the end exactly square it will be advisable to saw the roller off in a miter-box if possible. Otherwise the eye must be relied upon.

Never cut the shade to fit the roller. It is almost impossible to cut it the same width its entire length and the uneven edge will invariably show. Instead it should be torn. Lay it out on the floor and measure the desired width across the end that is to be tacked to the roller. As previously mentioned, the width should be about an inch less than the length of the roller for an outside job. For an inside fitting cut the shade a trifle wider in proportion; perhaps three quarters of an inch less in width than the length of the roller.

When the desired width has been marked make a slight cut at the mark and then grasp the stock in the fingers of each hand each side of the cut and tear it down with a brisk sweep of the arms. Two or three tears will carry the separation the entire length of the stock in a straight unbroken line that could never have been accomplished with shears. If the stock is good the line will be perfectly straight and the width at the bottom will be found to be exactly like that at the top. Remove the curtain stick, of course, and then saw it to fit the new width and reinsert it in the hem.

Tack the refitted shade to the roller so it is equally distant from each end and at right angles to it. Use small tacks or staples and place them about 6 inches apart. Be sure the edge of the hem at the bottom is on the inside of the window when the shade is hung.

Before inserting the roller in the brackets make sure the pawls in the ratchet end of the roller work easily and catch in the toothed trigger or in the flattened pin. If they act stiff, pry them back and forth with the screwdriver blade and apply just a drop of light oil to the pivots. Then wind up the spring several times by holding the roller in one hand and grasping the flat pin in a pair of pliers and rotating the roller with the hand. If the pawls catch at each revolution the action can be pronounced O. K.

With the spring partly wound up, roll the shade completely up on the roller and then insert the latter in the brackets. Do this so the shade will be on the far side of the roller next to the window trim. This will bring the round pin to the right which should be inserted in the bracket containing the round hole. Then slip the flat ratchet pin into the slotted bracket at the left. Pull the shade part way down and test the tension. If insufficient to carry the shade up again, remove the roller and roll the shade up on it once more and then repeat the operation until it can be unrolled its entire length and be carried up with a nice easy spring tension.

Attach the curtain pulls the last thing. Measure along the bottom of the shade to the exact center and then punch a small hole through the bottom of the hem and into the stick. The screweye attached to the pull can then be threaded in nicely.

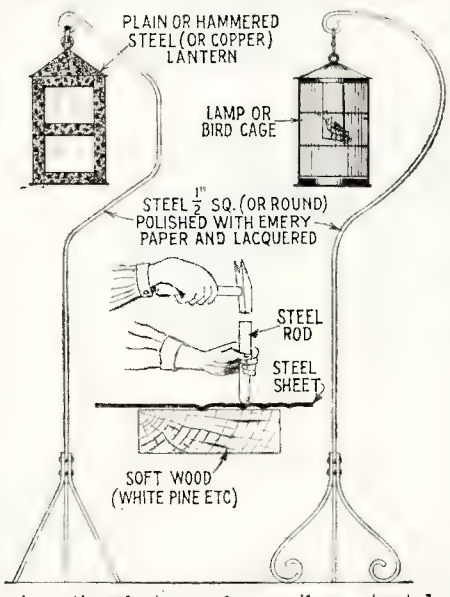
Always remember that a shade should be at least six inches longer than the length of the window to allow a little extra in pulling the shade down.

Above—tearing the cloth to size. Tacking the cloth on the roller. Oiling the trigger for free movement. Fitting finished shade in place.

# How to make it

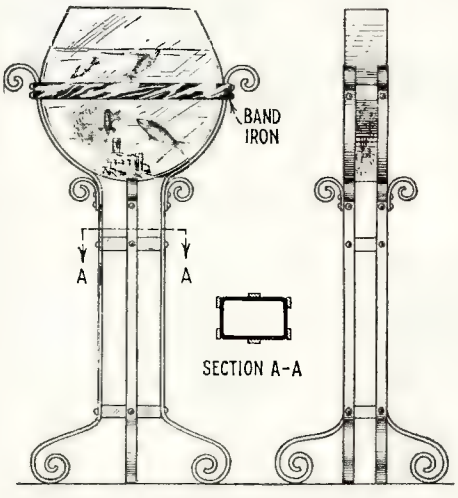
ARTICLES OF INTEREST TO EVERYONE

## Useful and Decorative Home Craft


PLAIN OR HAMMERED STEEL (OR COPPER) LANTERN
LAMP OR BIRD CAGE
STEEL 1/2" SQ. (OR ROUND) POLISHED WITH EMERY PAPER AND LACQUERED
STEEL ROD
STEEL SHEET
SOFT WOOD (WHITE PINE ETC)

**An antique lantern and an easily constructed bird-cage are illustrated above.**

THERE seems to be a big demand for articles such as described here, made from wrought iron or steel. The selling price of such articles is often high, but they may be constructed at a small cost. One of the most popular sheet metal finishes may be produced by using a steel rod and a block of soft wood as illustrated. The construction of the bird-cage needs no explanation. Two different metals, such as a combination of iron and brass, may be used effectively in the construction of the aquarium stand.




**The construction details of an ornamental aquarium are illustrated in the above drawing.**

The lamp consists of an old vase, an artificial parchment shade, an electric socket, and a few other minor items. It will be advisable to weight the base, so that the lamp will not tip over easily. This particular lamp was designed by Harold Jackson.

**A beautiful and useful table lamp may be constructed at a small cost as shown here.**

## Celluloid Craft for the Layman

CELLULOID craft is a very interesting art, and many beautiful and useful articles can be made from this material with little practice. Celluloid can be purchased in sheets of various colors and thickness, made especially for the home craftsman. The physical nature of celluloid makes it easily worked into any form. It can be carved, sawed, turned or otherwise manipulated with ease.

The articles shown here are easy to make and are good examples to start on. A set of oil colors and a couple of small brushes will be needed to decorate the articles when completed. Celluloid is easily bent into any desired shape by immersing it for a few minutes in water at about 120° F. It is bent and held as desired until cool. It will then retain that shape.

Celluloid cement, such as used for patching motion picture films, is made of two parts acetone and one part amyl acetate. This cement unites celluloid on the nature of a weld, and must be used where parts are to be fastened together. Slight pressure is required to make a strong joint. A fine-toothed coping saw is best for cutting this material. Edges are rounded with a file or fine sandpaper.

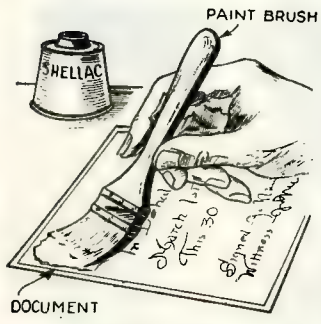
**The illustrations depict a few of the many useful and interesting articles that are easily made from celluloid. The decorative effects are obtained by the use of oil colors and bending and shaping the celluloid sheets.**

# Wrinkles

## RECIPES & FORMULAS

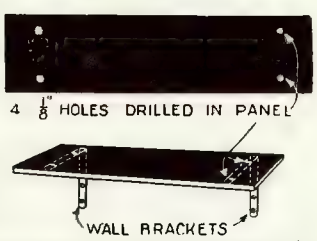
Edited by S. Gernsback

### WATERPROOFING DOCUMENTS



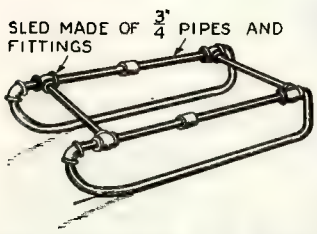

Where documents are exposed to water or placed in damp places they are soon ruined, even if they are placed in a glass frame. To prevent this, they should be given a coat of clear varnish or shellac. Scrap celluloid dissolved in acetone makes a good varnish for this purpose—H. R. Wallin.

### RADIO PANEL SHELF



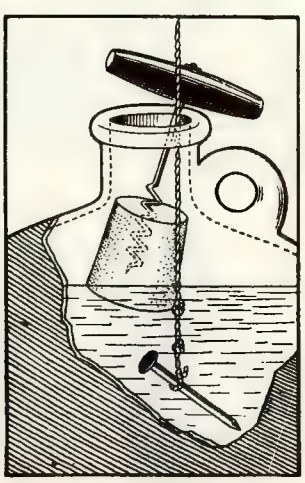

Small shelves for the laboratory can be made from old radio panels which are in fair condition. These are fastened to wall brackets, by means of small bolts, as shown. Either hard rubber, bakelite, or other composition panels may be used in this manner.—F. R. Moore.

### PIPE FITTING SLED



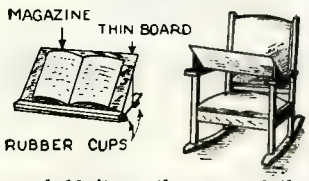

The illustration appearing here shows how a small hand sled can be made from ¾" pipe and fittings. This can best be accomplished by filling the pipe with melted rosin or lead, and then bending it to any desired shape. Any number of cross-pieces may be arranged in order to strengthen the sled. The two runners are first bent to the desired size and then the cross-pieces of pipe are put in place. —Victor Frederick.

### EXTRACTING CORKS



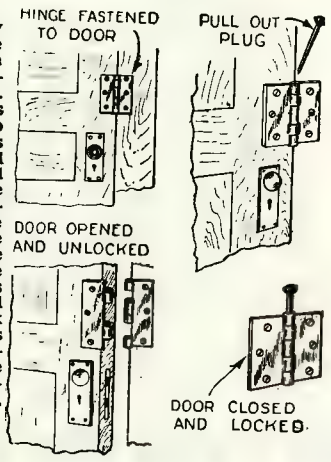
Corks which may have been pushed into the bottle by the corkscrew may be extracted by using the method illustrated here. This consists in tying a nail to a piece of string and dropping it into the bottle. The cork may then be squeezed up into the neck by pulling the string and the corkscrew twisted securely into the cork, which then may be extracted easily. —Contributor, send name and address.

### MAGAZINE RACK



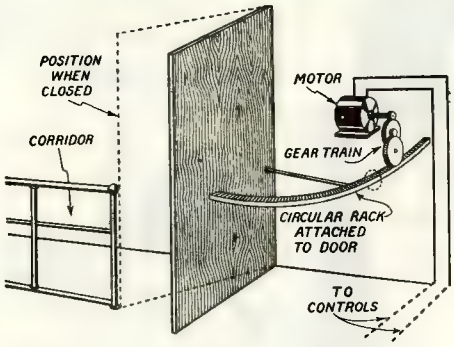

A simple magazine rack can be constructed as shown here. It is made of plywood and is very light. Four small rubber cups fastened to the base hold it on the arms of the chair without slipping. This rack can be made in various sizes, in order to fit the individual requirements.—C. R. Van. Reporter No. 16,643.

### EMERGENCY LOCK



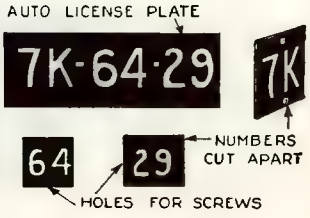

An emergency lock can be made from an old hinge as illustrated here. The hinge is fastened to the door as shown and then screwed in place, one leaf being attached to the door and the other to the jamb. The hinge peg is then pulled out. To lock the door, it is only necessary to place the peg in position. — W. Phillips.

### AUTOMATIC DOOR CLOSER



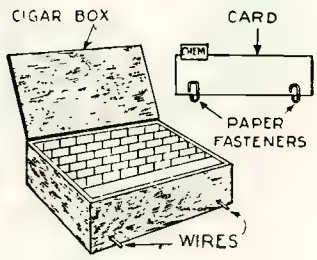

The automatic closing of a door can be accomplished easily by employing the method shown above. A circular rack attached to the door is moved by means of a gear train, actuated by an electric motor.—Je Sais Tout.

### USE FOR LICENSE PLATES



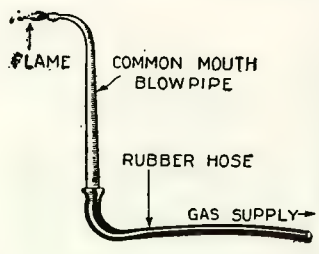

Old license plates can be cut apart and the numbers thus obtained used for various purposes about the home. — Contributor, send name and address.

### FILING CABINET



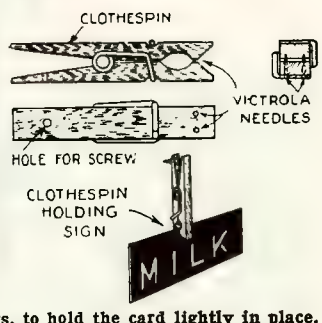

A simple filing cabinet can be constructed as shown. Paper clips are fastened to the bottom of cards and a wire is run through the box. A cigar box will serve for the cabinet itself. — Robert B. Bean.

### PRESSURE BLOWPIPE



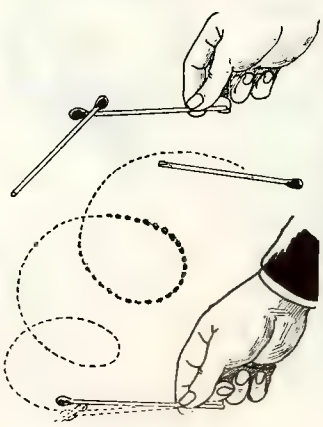

If a rubber hose from the gas supply is connected to a common blowpipe, a hot flame suitable for all blowpipe work will be obtained. The pressure obtained from the gas supply is sufficient. — Donald Manwaring.

### HOLDER FOR CARDS




A simple holder for the milk or ice card, or in fact for a notice of any kind, can be made from a clothes-pin of the type shown. It is held to a support, by passing a screw through one arm. Two phonograph needles are driven into one of the jaws, to hold the card lightly in place. Wilson G. Walters.

### MATCH TRICK



A novel match trick consists of making a match jump up into the air at the command of the performer. One match is held in the hand as shown, and only has to be tapped slightly to send the other into space. — Contributor, send name and address.

# Readers Forum

**SCIENCE AND INVENTION desires to hear from its readers. It solicits comments of general scientific interest, and will appreciate opinions on science subjects. The arguments pro and con will be aired on this page. This magazine also relishes criticisms, and will present them, whether caustic or not. So if you have anything to say, this is the place to say it. Please limit your letters to 500 words or less, and address your letters to Editor—The Readers Forum, c/o Science and Invention Magazine, 230 Fifth Avenue, New York City.**

### ROCKET IN SPACE

*Editor,* SCIENCE AND INVENTION

I have taken your valuable magazine for some time and have been a constant reader of the Readers' Forum. While reading February's issue, I saw where Mr. Bromwich from England wanted the Model Department stopped, and also other departments. I hope S. & I. will not stop these departments.

I read an article in the London *Free Press* where a chemist was going to fly to Venus in a tube like a bullet propelled by powerful explosions. Would these explosions have any effect in pushing the machine in the space between the two planets? How would he steer such a machine so as to hit Venus? A rudder would not have any effect in the ether, would it? I would not doubt that a machine could not reach the planets.

Hoping to receive the reply and to see more money grafts exposed, I remain,

H. J. SLACK,
Hope Bay, Ont., Canada.

**(We thank you very much for your communication to the Readers' Forum, and if space permits, we will publish the same. Unfortunately, there are so many subjects for this department on file, that we cannot possibly hope to publish them all.**

**Explosions properly directed would have a tendency to propel a rocket to the moon, or to any other planetary body. After the machine leaves the earth's gravitational pull and rushes out into space, it might be directed by two means: either by a rudder, or tubes on either side of the rocket. Now while it is true that the rudder cannot be affected by ether of the intervening space, you must remember that the explosions are exuding out of the tail of the machine and that these explosions can be directed so as to influence the rudder and tail, and this will of course influence the direction of the rocket travel.**

**Lateral explosions can also be made to direct the course of this rocket. If the machine is to swerve to the left, a discharge occurring on the right side at the rear end of the machine will produce the effect.—EDITOR.)**

### PAGING MR. BROMWICH

*Editor,* SCIENCE AND INVENTION:

Replying to Mr. Bromwich's letter of February, "No Models."

Why not abolish the magazine? I counted the departments you are desirous of discontinuing. They number five! You say the Model Department could be discontinued without serious damage. Were the Model and Constructor Departments done away with, the publishers would immediately feel the damage and would soon be looking for a warehouse to store their unsold copies in. I, for one, would not waste the time to buy the magazine. The first thing I do upon getting my copy is to look up the Model and Constructor Departments. I doubt if you have ever made a model of a ship; some day just try, maybe it will give you an evening's pastime. "Only woodwork" is your compliment to this department. It is more than "only woodwork," it is an art wherein are shown masterful skill and infinite patience.

I am not particular about the Magic Department, although it is interesting, but by all means keep the Model and Constructor Departments, for therein lies the joy and success of the magazine. To use an American slang expression, Mr. Bromwich, "You are all wet!"

I agree with you—SCIENCE AND INVENTION is an excellent magazine.

These are my sentiments and I think others will agree with me.

So much for Mr. Bromwich and his No Models, but I am desirous of seeing a new model started and not the prize winners copied. I suggest a four-masted schooner.

Hoping this letter will be given your consideration in due time, I remain,

R. RINKEL,
Stratford, Conn.

**(What more need we say after reading a letter of this nature? Mr. Bromwich is not desirous of seeing the Model Department continued. The above writer will no longer be a reader of this magazine if the Model Department is discontinued. The readers should come to the editor's assistance now and take him out of his dilemma. He can try to please them both, but how?—EDITOR.)**

### ENORMOUS MEN

*Editor,* SCIENCE AND INVENTION:

Permit me to direct your attention to a rather obvious misstatement appearing in the February, 1928, issue of SCIENCE AND INVENTION. On page 899, in the article by Dr. Damrau, the following sentence appears: "Frederick the Great had a mania for recruiting enormous men for his personal guard." If the editor will but reflect a moment, I feel certain that he will remember that it was Frederick William I, father of Frederick the Great, who had a predilection for tall men. While not particularly serious in a scientific magazine, such an error has no place in a journal of the standing of SCIENCE AND INVENTION, and I would suggest that a correction be made.

JOHN FRANCIS FAY,
Los Angeles, Calif.

AMAZING STORIES

IN OUR JUNE ISSUE:

THE INVISIBLE MAN, by H. G. Wells. While there have been many battles fought in our Discussions Department as to certain Wells' stories, the editor makes the prediction that "The Invisible Man" will be acclaimed by all the readers of AMAZING STORIES. "The Invisible Man" no doubt is a scientifiction story plus. It is one of those stories that is well nigh perfect.

THE BLUE DIMENSION, by Francis Flagg. Of course, you will remember Mr. Flagg's past stories, "The Master Ants" and "The Machine Man of Ardathia." In "The Blue Dimension," he has produced a real thriller. Here he takes us to another plane; a different world, and it is a most convincing story. Don't miss it.

THE GOLDEN GIRL OF MUNAN, by Harl Vincent. "Necessity is the mother of invention." Hatred, or a lust for revenge, also enables a person to perform wonders. What a very few scientists, exiled with a small group of radicals, finally invent on a small island off in the uncharted seas, is graphically told by our new author, who not only has a vivid imagination, but, being an engineer of high standing, has an adequate amount of scientific knowledge to draw from.

BARON MUNCHHAUSEN'S SCIENTIFIC ADVENTURES, by Hugo Gernsback. Mars, according to most scientists, is an almost inexhaustible source of interest, and our friend, the Baron, being avid for interesting information and experiences and having a knack for learning everything worth while knowing, continues, in his own manner, to tell us about the cities of Mars and how the planets look, as seen through the powerful Martian telescopes. He also advances an entirely new theory as to how the Martians might make life bearable on their desert planet.

And Others.

**(We are certainly glad to make this correction and pass it along to our readers. We wonder how many readers noted this misstatement? Judging by the inquiries, there must have been quite a number. SCIENCE AND INVENTION Magazine tries to be 100% correct all the time. Of course, we make no claim to infallibility. When an occasional error does appear, it is generally of such a nature that the facts presented are in no way distorted or incorrect. This error is one of a very few. However, it is of true historical interest.**

**We wish to thank Mr. Fay for catching the oversight, not to say for the kind compliment he has paid us.—EDITOR.)**

### SUBMARINE SCALES

*Editor,* SCIENCE AND INVENTION:

In a recent newspaper clipping there was a statement made that an inventor of Baltimore, I believe he is a Mr. Gardner, claimed to have invented a device operating on the principle of a weighing machine for the lifting of submarines. He was going to use a derrick, with a submerged tank on one side and cables to go to the submarine on the other. The cables were to grapple the submarine after which the tank was to be filled with water and the weight of the filled tank would lift the submarine. He said that the derrick would have a lifting power of 2,500 tons.

We have had a discussion on this method of raising a submerged vessel, and I would like you to clear up the points brought out in the controversy.

"A" claims that when a tank is filled with water there is no increase in weight.

"B" claims that water has weight and a tank large enough to hold a quantity of water equal in weight to the submarine is all that is necessary. Which is correct?

JOHN M. HERRICK,
New York City.

**(If the derrick were so arranged that the lifting tank would remain in the air at all times, then a tank containing water equivalent in total weight to the weight of the submarine is all that is required. A submarine of the type of the S-4 weighs 1,092 tons. The engineers have figured that the buoyancy required to lift it was in the nature of 750 tons, partially because of the fact that some of the air compartments were still intact. The suction in this particular case was not very great, according to reports, but there are times when a lift of 1,600 or more tons would have to be exerted in raising a submarine of a weight equivalent to that of the S-4.**

**We have here merely taken the weight of the tank while in air into consideration. Let us now refer that to the scene of operation. In the first place, we would have to have a derrick capable of not alone sustaining the weight of the submarine, but a weight equivalent to the force necessary to break the suction grip. Assuming this to be in the nature of 1,600 tons, it would be essential that our derrick be capable of sustaining a weight of another 1,600 tons for the tank, and perhaps 100 tons additional for incidental equipment such as cables, chains, etc. Inasmuch as the average large size crane is capable of lifting a weight of but 300 tons, you can well imagine what the possibility is of constructing a crane with a capacity of more than ten times this.**

**Technically, "A" is correct. It is conceivable to have a tank weighing but one pound and large enough, let us say, to hold a ton of water. If this tank were immersed in water, its total weight would only be seven-eighths of a pound. This is because of the specific gravity of the tank's contents being practically the same as that of the surrounding water. It follows then that the tank would have to weigh about one-eighth more than the lift which is expected of it, because the iron of which it is made loses approximately one-eighth of its weight when immersed in water. Unless the tank were made solid, it would have to be larger than the submarine, inasmuch as submarines have quite a considerable amount of machinery confined within their walls.**

**Imagination alone can picture the size of a derrick having a capacity more than ten times that of the Merritt-Chapman derrick which was sent to the scene of the S-4 operation.—EDITOR.)**

### INCREASING HEIGHT

*Editor,* SCIENCE AND INVENTION:

I would like to know something about height increasing, particularly through exercise. There is a man who advertises a course and some apparatus for increasing the height. The apparatus does not seem to amount to much, so I think there must be a catch in his claim somewhere. It would be a revelation to me if all he claims is true, for I am five feet four inches tall, and increasing my height would help me out greatly.

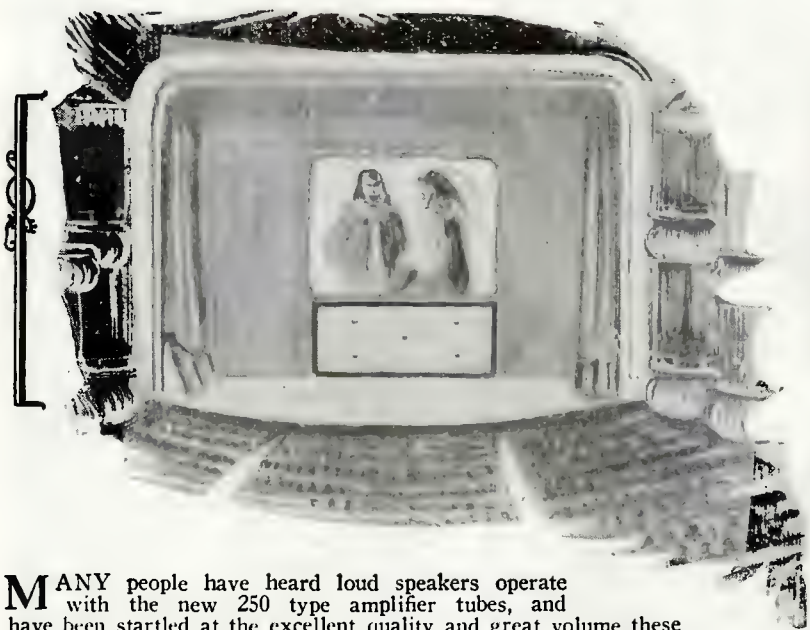
R. H. BRINKS,
Quincy, Ill.

**(Exercising can make any man taller. If you don't believe it, measure your height, and then stretch yourself out fully without rising on your toes; you will find that you have probably gained an inch and three-quarters in height. The difficulty is that the average man slouches too much. He makes no attempt to stand straight and erect. Hence, he is always shorter than he would be if he but took care of his muscular development. Stretching is always good, but it need not be done with apparatus.**

**Many years ago, appliances appeared on the market which contained receptacles for the feet and a bandage for the head. The person occupying apparatus which resembled a couch could stretch himself to his heart's content.. With this machine it was claimed that the inter-vertebral cartilages were increased in thickness; hence, the**

*(Continued on page 172)*

# Giant Speaker Fills Theatre



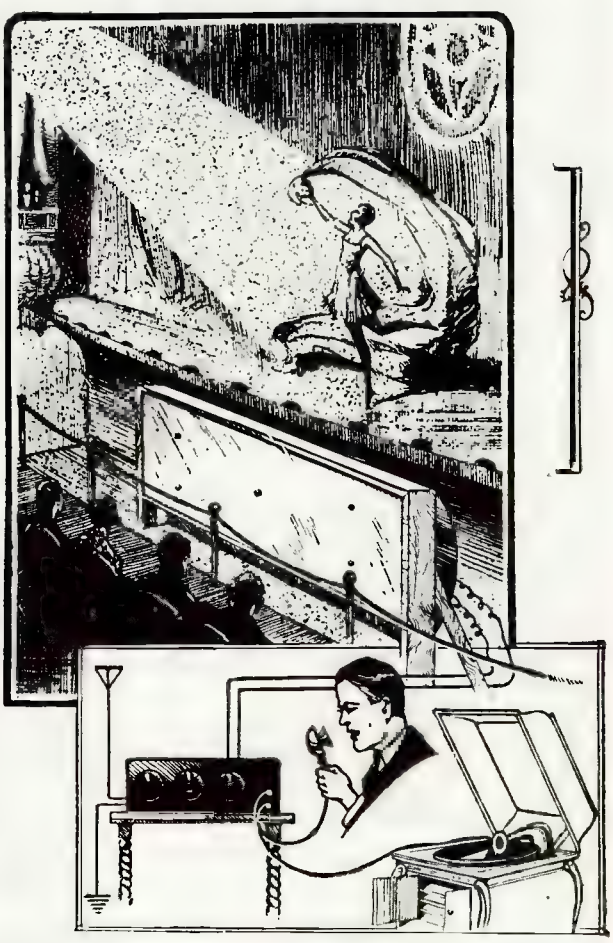
**At the left is an illustration showing how the huge cone speaker is placed in back of the screen at the bottom. This in no way interferes with the picture and when the screen is raised the loud speaker clears the proscenium arch.**

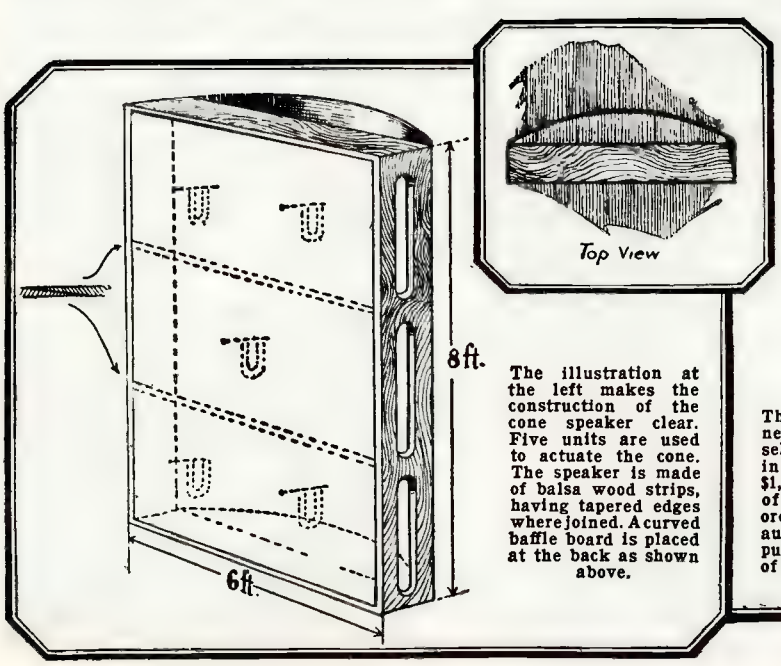
MANY people have heard loud speakers operate with the new 250 type amplifier tubes, and have been startled at the excellent quality and great volume these tubes give in conjunction with a loud speaker capable of carrying the output. However, these tubes are not large enough for handling a loud speaker in a large auditorium such as a theatre. The present article concerns a huge balsa wood loud speaker, measuring about 6 by 9 feet, which was installed in a New York theatre to take the place of the orchestra. The orchestra previously employed by this theatre comprised eight men, drawing a salary of $880.00 a week. With an installation such as the present one costing between $1,000 and $2,000, the cost of the installation is soon returned. The cost of operating this large amplifier is very small by comparison to the cost of the orchestra.

The loud speaker embodied a special balsa wood diaphragm, built up from several strips of balsa wood. The balsa wood used was about ⅛ inch thick. Where the strips were joined they were cut with a long taper on the edges, and then cemented with rubber cement, such as used for tires, etc. The balsa wood diaphragm was cemented and tacked to the ⅞ inch wood supporting frame, shown in the pictures, and a curved baffle board was attached to the back of the speaker in the fashion illustrated. Instead of trying to drive this large diaphragm with a single cone unit, five cone units were suitably supported and attached to the balsa wood diaphragm in the manner indicated by the drawings.

The power amplifier had a single stage of audio frequency equipped with two 250 watt transmitter tubes. The plate circuits of this push-pull power amplifier stage were supplied with direct current at 1,500 volts from the dynamo of a motor-generator set, using here one of the units utilized in small radio transmitting stations. Looking at the wiring diagram presented herewith, two stages of tuned radio frequency are shown, these and the tuned detector circuit being placed in regular aluminum shield cases. The two R.F. stages are stabilized by nega-

(*Continued on next page*)






**The illustration at the left makes the construction of the cone speaker clear. Five units are used to actuate the cone. The speaker is made of balsa wood strips, having tapered edges where joined. A curved baffle board is placed at the back as shown above.**

**The large wood diaphragm could be concealed in the orchestra pit beneath the stage, as illustrated above. Radio programs, phonograph selections and announcements can be given with the system described in the text. With an installation such as this, which may cost between $1,000 and $2,000, the initial expense involved is soon returned. The cost of operating the amplifier is small in comparison to the cost of an orchestra. The power amplifier used with this speaker employs a single audio stage, utilizing two 250-watt transmitter tubes connected in push-pull style. The plate current is obtained from a direct current dynamo of a motor-generator set, which delivers 1,500 volts. The wiring diagram shows the circuit arrangement.**

# Giant Speaker Fills Theatre

(*Continued from previous page*)

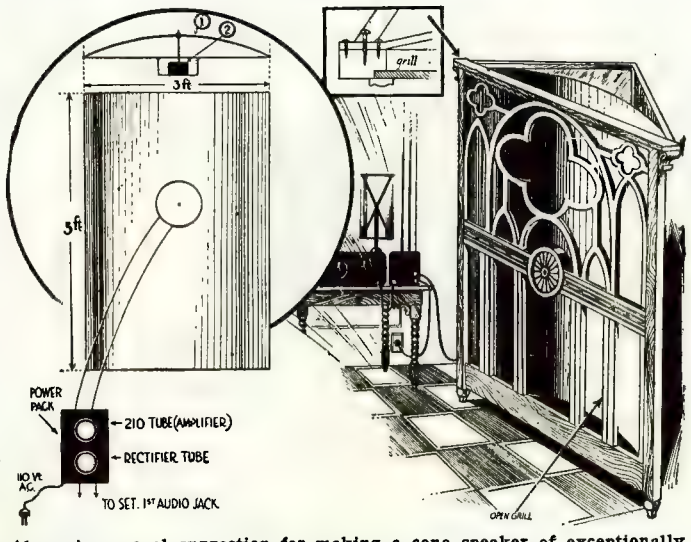
tive bias on the grid circuits of the tubes. For the detector circuit the engineer installing this ultra-powerful amplifier and loud speaker, which fills the whole theatre with music, found that the negative bias on the grid of the detector tube was preferable to the usual grid leak and grid condenser. An ordinary detector tube is employed and a closed circuit jack, connected in the grid circuit of the tube, permits the announcer to plug into this circuit with a microphone and battery in series with it if desired; or a phonograph with electric pick-up can be plugged in whenever desired. Both radio and phonograph music are used at this theatre.

In regard to the electric pick-up, this engineer explained to the writer that he found a carbon button microphone type of pick-up, superior for this particular installation to the magnetic pick-up. An extra battery was connected in series with the microphone, and is here shown in the diagram.

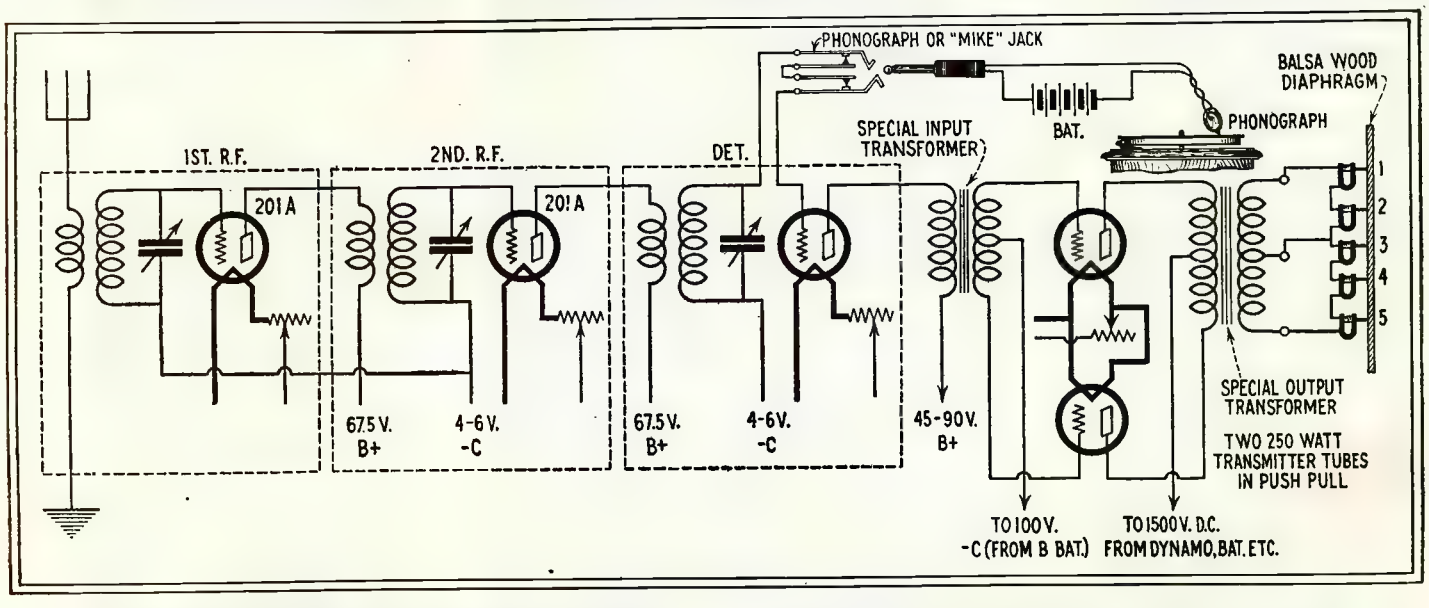
The two push-pull transformers, including the input and the ouput units, were built by one of the leading transformer companies and were specially made for the requirements of this installation. In other words, the push-pull transformers have to correspond in size with those used with the two 250 watt tubes in a radio transmitter. The impedance of the tapped secondary of the output transformer is arranged so that one section of the secondary has an impedance suitable to match that of two cone units connected in series as shown; while the impedance of the other section of the transformer secondary matches the impedance of the three cone units connected in series across it.

As the pictures show, a giant loud speaker of the type here described, can be placed in the orchestra pit, or as in the theatre in question, it can be mounted on a special drop curtain. The loud speaker is mounted on the lower part of a drop curtain, so as to be below the small screen dropped in front of and just above it for "movies;" when the "movie" screen is raised, and the black drop containing the loud speaker is also raised to the average height of the curtains on regular theatre stages, the loud speaker is still facing the opening at the top of the proscenium arch, giving a clear sweep for the music out into the auditorium.

As will be noticed from the schematic diagram the phonograph pick-up is plugged into the grid circuit of the detector tube. This acts as a filter and eliminates any undesirable scratchy noises. The jack used here is of the closed circuit type so that the grid circuit is complete normally. When the plug is inserted the microphone or phonograph pick-up is connected in the grid circuit. No audio stage is used before the push-pull amplifier, the output from the detector is fed directly into the amplifier. Ordinary 201-A type tubes are used in the radio frequency and detector sockets. The "C" bias method of detection is used, and as the value of the negative grid bias is increased the output impedance of the detector tube increases. In using this method of detection several effects may be noticed as the result of the condition mentioned above. If a fall-off in quality is noticed the lowest value of grid potential is used which is found satisfactory in actual operation for a given tube and receiver. The next condition is that as the negative grid potential is increased, the tube impedance increases so rapidly that the load of the tube on the transformer primary decreases to a point where the audio amplifier may jump into oscillation at a rather low frequency. The remedy for this is to decrease the value of detector "C" bias, or the connection of a leak resistance across the secondary of the audio transformer, thus loading the secondary of the transformer and, due to the coupling, the primary as well. All wiring is kept as short and direct as possible and the circuit condensed as far as is practical. Every precaution is taken to see that trouble does not arise in the detector circuit, either individually or as the result of the cumulative effect of associated circuits. It is best to by-pass the output of the detector circuit before it reaches the audio amplifier. It may frequently be necessary to insert a choke coil in the output plate circuit of the detector tube. This choke should have an inductance of about 2½ millihenries and will further aid in the isolation of the radio-frequency currents of the receiver and will promote stability. The "C" bias detector has a greater handling capacity than the grid leak and condenser. In the case of gang control the circuit constants of the detector circuit will be essentially the same as for the radio frequency amplifiers. As will be seen in the diagram the bias is not critical but is adjusted in actual operation for maximum sensitivity on weak signals. Thus by the use of a "C" bias detector in the theatre radio installation, many advantages are obtained which would otherwise be lost if grid leak and condenser are used.




**Above is a novel suggestion for making a cone speaker of exceptionally artistic and pleasing design. It measures 3 feet by 5 feet and is built with balsa wood or ply wood. The front is covered with a grill work and the cone is supported at each end, as shown. The cone is depicted at 1 and the unit at 2.**




**Above is the circuit diagram of the set used with the speaker described in the text for the theatre installations. Two stages of R.F. are employed.**

**Two 250-watt transmitter tubes in push-pull are used for the amplifier. A jack provides for the insertion of phonograph or "mike" plug.**

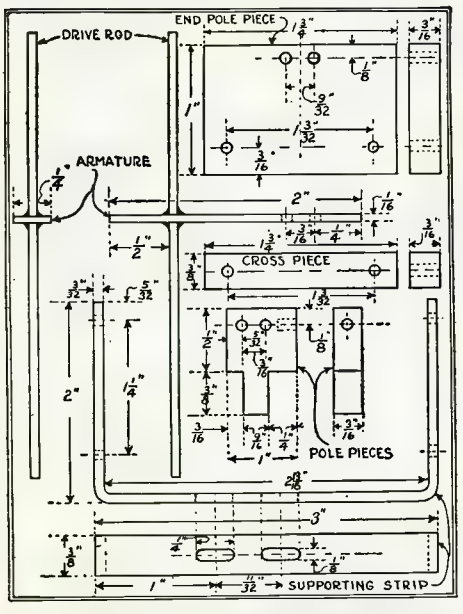
# Making a Double-Cone Speaker

## Constructional Details of Unit and Cones Fully Explained

THIS home-made loud speaker is constructed on the lines of a standing double cone loud speaker without case. Besides the large low pitch cone, it has a smaller very high pitch cone. Both cones are independently supported by the wooden frame, and are actuated by the same unit. The principle of the arrangement is shown in Fig. 6. The wooden frame is connected firmly on one side to the foot piece or pedestal, and on the other side with the unit. The armature of the unit has a little rod passing through it which actuates the two cones simultaneously. The membrane of the large cone brings out the lower register very well. The small cone which, on account of its vertex angle and of the use of thinner paper, is tuned very high and reproduces the higher range of frequencies. Speech is reproduced especially well by this combination.

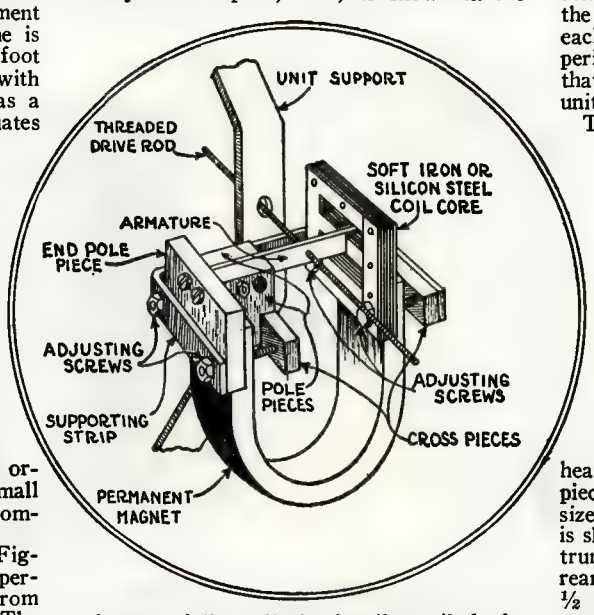
Experiments with each of the two cones can be carried out. In receiving a symphonic concert with the small cone, the bass notes are almost entirely missed, while with the large cone also connected, they come out almost perfectly. On the other hand, ordinary speech is best given by the small membrane. By exciting both cones complete reproduction is given.

The reciprocating unit is shown in Figures 6 and 1. In Figure 1, there is a perspective diagram, omitting the coils, from which all the parts can be recognized. The dimensions of the single metal parts can be taken from Figs. 2 and 3. For the magnetic field, an ordinary horse-shoe magnet with a distance of 1½ in. between the poles on the inner side is used. Slight variations from this size are immaterial and can be compensated by changing the pole pieces. The laminated soft iron or silicon steel core is built up from transformer plates, following the dimensions given in Figure 3. Two templates are cut out of thin sheet brass and holes to give the position for the rivets are drilled. These marks can be transferred to the laminations through the holes in the template. The rivet holes are drilled through each piece. Drilling all the sheets at once, placed one upon the other, is not possible, because the plates shift about.




**Constructional details of the supporting strip, cross piece, pole pieces, armature and drive rod are given in the above drawing. Fig. 2.**

The number of sheets of steel or course depends upon the thickness of the individual pieces. The complete core should be 5/32 in. to 3/16 in. thick. After being adjusted and polished on both sides, the plates receive a coat of shellac and then are laid up alternately in two piles, A-B, as shown in the




**A view of the unit showing the method of assembly appears above. Note the position of the drive rod which is used to actuate both the large and small cones. Fig. 1.**

illustration and rivets are passed through the two sets of plates. For rivets the best material is thin copper wire. When the two sets of plates are ready, they are pushed together after the coils are in place on the metal tongues and the rest of the rivets going through both sets are introduced. The air gap between the projecting cores must not be widened, and the surfaces must be made perfectly even. This operation is of great importance.

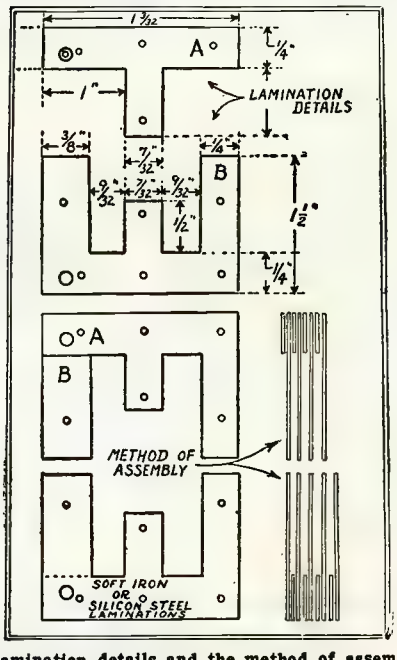
With a hack-saw the opening is enlarged until a flat file of 1/16 in. in thickness can pass through, and this is used for further widening of the opening; so as to get perfectly even faces, it is well to have the file operated by two people at once. The air gap should be about 1/16 in. wide. In order not to make the air gap too large, it is well to determine the size by experiment.

The securing of the core which is only supported by being clamped to the magnet poles will be clearly understood from the illustrations. With the exception of the magnet armature and pole pieces, which are made of thin iron, all the rest of the metallic parts are of brass or copper. The pole pieces, by which the armature is secured, are only held in place by clamping. The cross piece takes the ends of the clamping screws. The thin-threaded drive rod is soldered to the armature. No special arrangement for adjusting the armature is provided as one permanent adjustment suffices. This is done approximately by setting the pole pieces accurately with reference to the armature. The fine adjustment can be done by moving the core and by varying the tension of the adjusting screws. The aramture must pass through the center of the air gap without touching. The four terminals of the coils go to terminals on a piece of hard rubber, held in place by screws, Four wires go from these four terminals to four terminals on the base. The resistance of the coils must range from 1400 to 2000 ohms. It is important that the impedance of both coils shall be the same. By using forms for winding the coils of identical dimensions, the ohmic resistances can be made the same. These forms are made up of pasteboard saturated with shellac. Number 40 enameled wire is used for the coils. The correct number of turns for each of the windings is best found by experiment, although it will usually be found that when the coil core is wound full the unit will work satisfactorily.

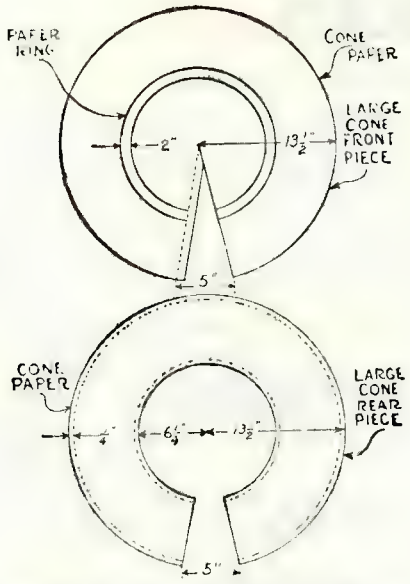
The unit represents a system with polarized armature. The armature polarized by contact with one pole of the horse-shoe magnet passes between the two projections of the core which, with reference to the armature, are separately magnetized with similar polarity. When all is motionless, there is no magnetic pull exercised on the armature through the closed circuit of the laminated core. There is an almost complete passage of the magnetic lines of force produced by the alternating current, which cause the vibrations of the armature.

The double cone is made out of heavy standard cone paper. A conical front piece and a rear support for the same, whose size is given in Figure 4; are glued together is shown in Figure 5, so as to make a double truncated cone. The edge of the smaller rear cone must be bent out for a depth of ½ in. after being slightly scored with a razor blade. Before gluing together, they are placed one upon the other as shown in the figure. Paper clips are then placed at short intervals so as to keep the two apart and then tube cement is introduced between the surfaces which are next clamped together during the drying. The large cone is stiffened by gluing a ring of the same paper 2 in. wide across the center. This paper disc must be glued to the large disc while it lies flat as in Fig. 4.

For making the small cone, we must use thin, lightly coated, common white drawing paper. The dimensions can be taken from Figure 5. The large cone with the circular opening of the supporting piece with the large opening can be directly clamped, be-

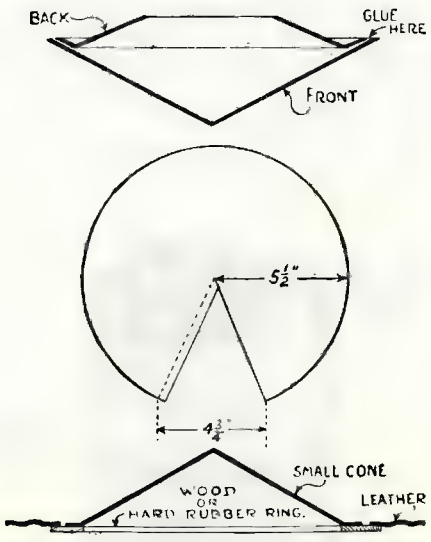



**Lamination details and the method of assembly are given above. Either soft iron or silicon steel may be used. Fig. 3.**

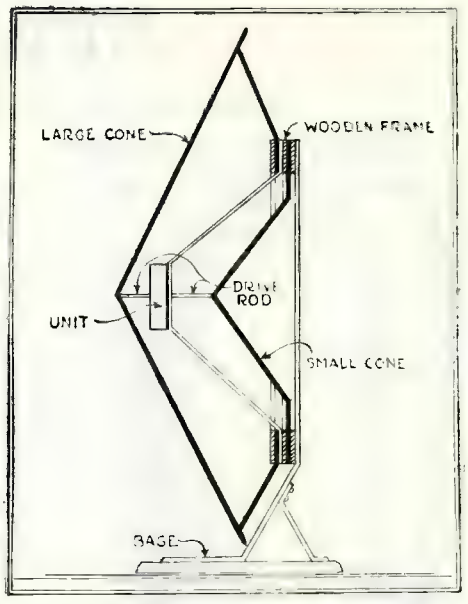



**Both the front and back faces for the large cone are shown above. A paper ring 2 in. in diameter is glued on the front of the cone as shown. Fig. 4.**

cause the connection of the two cones gives a construction readily susceptible to vibrations. The additional support for the smaller cone to keep it in tension requires a flexible arrangement for its support. The more flexible it is the more will its action approach that of a horn. The cone is fastened to the same opening with rings of flexible but not elastic material, glove leather from discarded gloves is the best. The diameter of the base of the small cone is less than that of the frame. It need not be strongly secured because disturbing natural tones might come in. The paper cone is not directly glued to the leather ring for in this case the edge might be stretched. The first thing is to grip the edges of the cone by gluing to a very thin wooden or




**The uppermost illustration shows the method of gluing together the large cone, the next gives details of the smaller cone, and the last one shows how this cone is mounted. Fig. 5.**

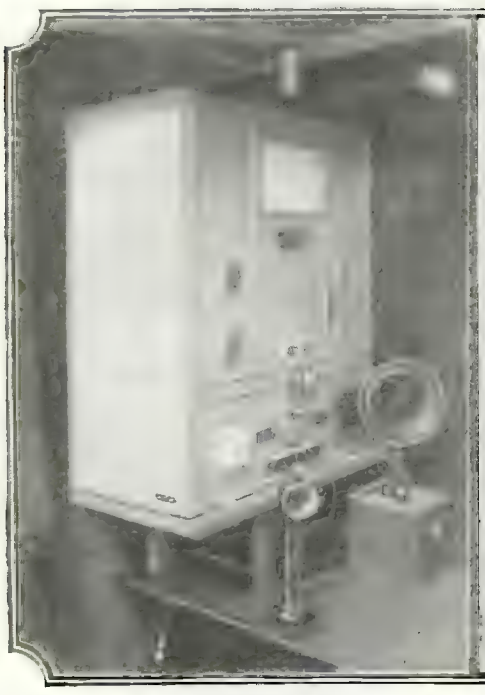



**A view of the completed speaker, showing the placement of the two cones and the unit appears above. Fig. 6.**

hard rubber ring, which of course should be perfectly even. Soft wood well seasoned is better than hard wood as the latter almost always shrinks after awhile. Before gluing, the edges of the paper should be moistened. The wooden ring is then glued to the leather ring as shown in Fig. 5.

—*Funk Bastler.*

# A RADIO-EQUIPPED YACHT



**Above—the radio installation.**

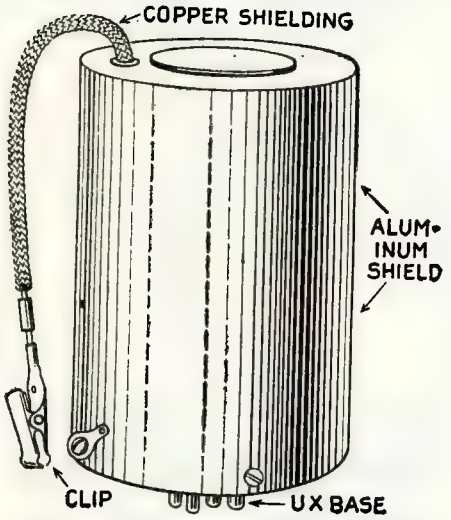
**Above is a view of the radio-equipped yacht "Crusader" riding at anchor.**

THE motor yacht "Crusader" owned by Mr. A. K. Macomber, of California, is elaborately fitted with the most up-to-date radio equipment. Radio programs can be picked up by the yacht over long distances and it is safe to say that there must be few parts of the world where the "Crusader" will be without radio entertainment. The owner has arranged to transmit his own radio programs from his yacht to the shore whenever he is in camp. When on a hunting expedition, the party will carry a number of portable receivers which will enable them to pick up telephone conversation or music transmitted by the radio telephone outfit installed on the yacht. Almost every room on the ship is equipped with its own loud speaker. Transmission and reception of commercial messages, news, and weather reports is also made possible. A 1½ kilowatt continuous wave transmitter, and a 1½ kilowatt quenched spark gap transmitter, enable the ship to keep in communication with commercial radio stations over long distances. The "Crusader" is also fitted with a ¼ kilowatt radio telephone set which is very easy to operate and supplies the party with private telephone service between its headquarters on the yacht and any camps which may be established during the cruise. The radio receiver is a 7 tube affair of commercial design. Automatic alarm signals in the cabins of the captain and the owner of the craft advise when the yacht is being called, thus obviating the necessity of an operator being on duty at all times. The owner is planning a hunting expedition in Africa and it is expected that the party will keep in touch with the boat, at all times, by means of portable radio receivers.

# NEW RADIO DEVICES

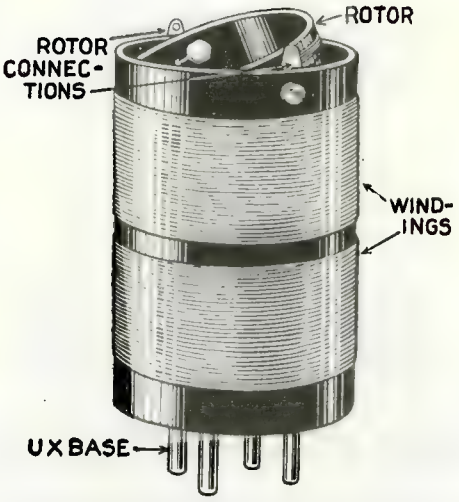
## Accessories Recently Developed Which Will Be of Value with Any Radio Set

### SHIELD GRID IMPEDANCS




**Above is a view of a new shield grid radio frequency impedance. Each unit is entirely enclosed in a metal shield and is fitted with a UX base.**

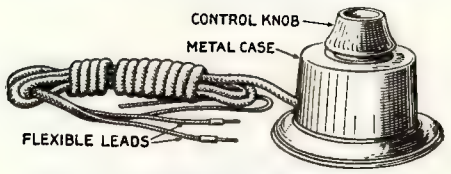
ONE of the western manufacturers has recently developed a plug-in radio frequency impedance to be used with the new shield grid tubes. This unit is fully enclosed in a heavy aluminum shield and can be plugged in any standard UX socket, as it is fitted with a UX base. A shielded clip lead extending from the top of the impedance is provided for the control grid connection on the shield grid tube. Copper braid drawn over the wire provides the necessary shielding and in order to prevent the control grid clip from coming in contact with any part of the grounded circuit, a short piece of insulation has been interposed between the clip and the copper shield. A lug which makes contact with the aluminum shield provides for the ground connection. Replacing your old tubes is now a simple matter if the plug-in impedances are used, and as each unit is properly designed and matched in the laboratory of the manufacturer, a considerable gain per stage is to be expected when using the 222-type tubes. The same manufacturer also makes plug-in oscillator couplers, of which one view is shown here.




**A plug-in oscillator coupler which is made by the same manufacturer is shown above. This also is equipped with a standard UX base.**

### TABLE VOLUME CONTROL

A WELL known manufacturer of variable resistors has recently brought out a new table type volume control which is attractively housed in a brown metal case with a felt covered base. Long flexible leads are provided for the connection to the receiver and an insulated knob placed at the

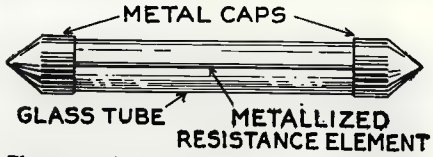



**A new volume control designed to be conveniently placed on the table, or on the arm of the chair, is shown above.**

top provides for varying the resistance, and thus controlling the volume. The resistance range is from about 0 to 500,000 ohms, and the resistor will handle up to 20 milliamperes of current.

### GRID SUPPRESSOR

ONE of the largest resistance manufacturers in the east has developed a grid suppressor, which is of the handy cartridge type. It is similar in appearance to a grid leak and will fit the standard grid leak mountings. It is available in a large number of values from 250 to 3000 ohms. The unit is hermetically sealed, of the metallized

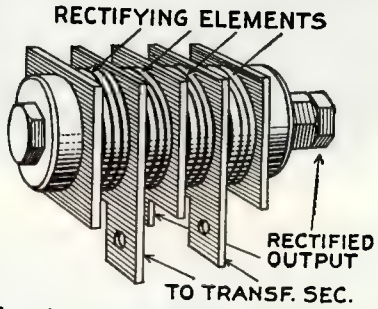



**The new grid suppressor, which consists of a metallized resistance element encased in a glass tube, appears above.**

filament construction, and therefore is free from troublesome inductive or capacitive effects. These units have been especially designed to prevent oscillation in radio frequency stages.

### DRY RECTIFIER

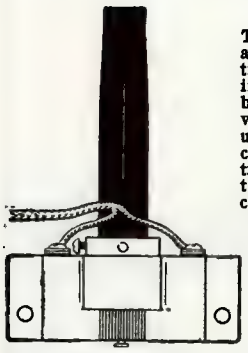
A NEW dry rectifier of the full wave type, designed for trickle chargers and "A" power devices, with transformers having a secondary voltage from 9 to 11 volts, has been placed on the market by a Missouri radio manufacturer. Several types of these



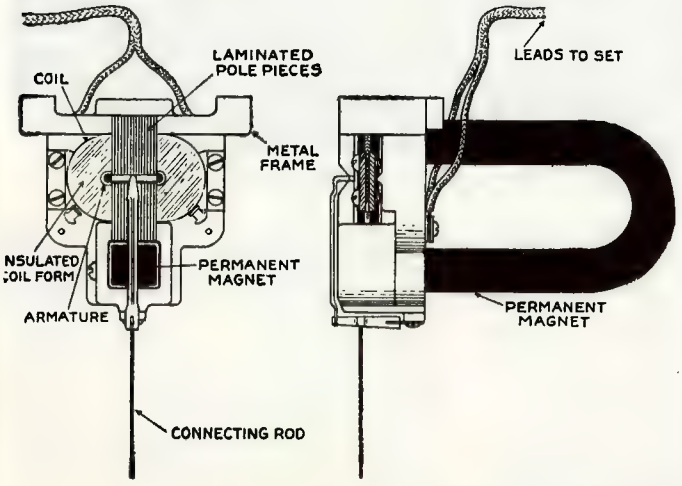

**Above is a view of the dry rectifying element of the full-wave type.**

rectifiers are made one of which is illustrated here. The full-wave rectifying units can be had to withstand a current drain as high as 250 milliamperes. The unit is compactly built and is of the metal disk type.

## CONE SPEAKER UNIT



**Three views of the new cone speaker unit appear here. The unit is of sturdy construction, and is so designed that it can be mounted in a number of ways. The two holes in the base which are shown in the end view provide for the mounting screws or bolts. When used with proper cone, the unit will give excellent results and reproduction over the entire musical range. The coil is carefully protected against moisture and temperature changes by a specially designed insulated form.**




A NEW cone speaker unit of sturdy construction and fine reproducing characteristics has recently been put on the market by a well known cone speaker manufacturer. The unit is of the iron armature type and the motion of the connecting rod is stepped down to about one-third of that of the armature by a cleverly designed mechanism. The impedance is such, that it can be used with 201-A type tubes without employing special output devices. A heavy base provides for good mounting and the rigid support of the unit itself. The pole pieces are of the laminated type and a long length of flexible cord has been provided for connection to the radio receiver. The unit may be mounted in a number of different positions and the metal frame is provided with the necessary mounting holes.

*Names of manufacturers of parts supplied upon request.*

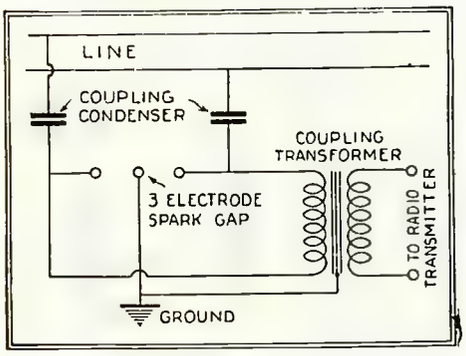
# RADIO ORACLE

**In this department we publish questions and answers which we feel are of interest to the novice and amateur. Letters addressed to this department cannot be answered free. A charge of 50c. is made for all questions where a personal answer is desired.**

### WIRED WIRELESS

(624) J. B. O'Sullivan, Philadelphia, Pa., asks:

Q. 1. Will you kindly publish a diagram showing how the radio transmitter is coupled to the line in a wired wireless system.




**Above is the hook-up of a wired wireless system, showing how the transmitter is coupled to the line.**

A. 1. On this page you will find illustrated a diagram which shows the method used in the above mentioned system of radio transmission. By utilizing high frequency currents, it is possible to superimpose these currents on to lines or circuits which are normally carrying other currents, such as, telegraphic, telephonic, or power circuits. This can be carried out without interfering with the normal use of the lines or circuits. An ordinary radio transmitter is coupled to the circuit which is to be used as the medium for the transmission of the signals. The action of the power lines is to act as a guide for the radio frequency energy between the transmitting and receiving stations, instead of allowing this energy to be radiated in all directions. The transmitter is usually coupled to the line through a coupling condenser, or the coupling may be provided through the capacity of a wire stretched near the power line, but suitably insulated from it. The coupling condenser method provides greater security, as it is not affected by atmospheric conditions which might cause damage to the coupling wire. The low potential terminals of the two coupling condensers are preferably connected to a three electrode spark gap, the middle point of which is grounded so that in case of a breakdown or accidental flash over, no excessive voltage will be applied to the radio apparatus. When this method is used with low voltage lines, no special apparatus is required for the condensers. When using high tension networks, however, the condensers must be larger, since they must be capable of withstanding the line voltage with a good factor of safety. Carrier current operation has the advantage over ordinary wire communication inasmuch as it is less liable to interruptions during storms. Furthermore, when there is a break in the line, there is usually sufficient capacity across this gap to convey enough energy to be picked up by the receiver.

### CHOICE OF INTERMEDIATE FREQUENCY

(625) D. Stanton, Somerville, Mass., writes:

Q. 1. Will you kindly tell me what is considered the best intermediate frequency to be used with a superheterodyne receiver?

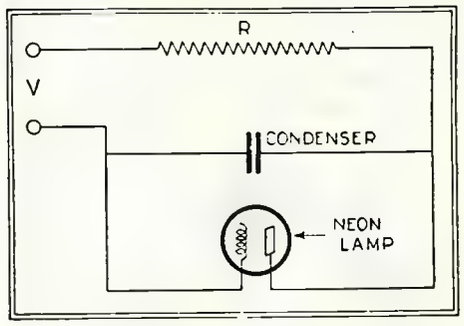
A. 1. The beat frequency or intermediate frequency at which a superheterodyne is to operate, must be above the audible range. The low limit of intermediate frequency should be at least 20 kilocycles, and in actual practice 30 kilocycles has been found to be the lowest practical frequency. The great amplification of superheterodyne receivers is largely due to the fact that this amplification is carried out at low frequencies. The lower the frequency, the greater will be the stability and consequently the amplification, the power and the sensitivity of the receiver. Taken from this standpoint, it is desirable to work at the lowest possible intermediate frequency. On the other hand, the lower the intermediate frequency, the closer it comes to audible frequencies and the greater will be the amplification of all kinds of low frequency noises, such as power line interference, static, and the like. The low frequency amplifiers are also less selective than the high frequency types. By using at least three intermediate stages and a good filter, or using all air core transformers, it is possible to obtain sensitivity, regardless of the frequency employed. The lower the intermediate frequency, the closer together will be the signal frequency and the beat frequency, or heterodyne. This may allow interference from powerful local stations, and it always brings in stations on the oscillator dial at two points which are quite close together.

### MEASURING CAPACITY

(626) H. Ferriera, Superior, Wisc., asks:

Q. 1. Can you tell me how it is possible to measure the capacities of condensers by using a neon lamp and also publish a diagram of the hook-up, if possible?

A. 1. On this page you will find illustrated a diagram of the condenser tester using a neon lamp. This is a simple form of tester and can be used for approximate measurements of capacity. It involves the use of the properties of the neon lamp. If a condenser is shunted by such a lamp, in which the discharge does not commence until a certain voltage is reached and is extinguished when this voltage falls below a certain value, the light of the lamp will become intermittent. The voltage is applied at V and should be in the nature of 200 volts or more, and if R is rated at 1 megohm or




**The above diagram shows how a neon lamp may be employed for measuring the capacity of condensers.**

more, the lamp will flash intermittently at a rate determined by the voltage V, the capacity of the condenser, and the resistance R. By counting the rates of flashing obtained, with two condensers, their capacities can be compared. Thus, if the value of one is known, the capacity of the other can be calculated approximately. The rate of flashing is very nearly inversely proportional to the capacity.

### OSCILLATIONS

(627) M. D. Ullman, Augusta, Maine, asks:

Q. 1. What are the general things which have an effect upon oscillation in a radio receiver?

A. 1. The tendency to oscillate increases as the frequency increases or as the wavelength decreases, other things remaining the same. This is also true of regeneration. A receiver may deliver very weak signals from high wavelength stations, which are of low frequency. The same receiver may be very satisfactory at medium frequencies and wavelengths and may be almost impossible to control of to prevent from howling at low wavelengths and high frequencies.

We may have oscillation with radio frequency amplifier tubes, with detector tubes or with audio frequency amplifier tubes. In a receiver which includes all three kinds of tubes the greatest tendency to oscillate is found in the second radio frequency tube or in the third radio frequency tube if a third one is used. The next greatest tendency toward oscillation is found in the detector tube. The tubes in the audio amplifier have the least tendency to oscillate.

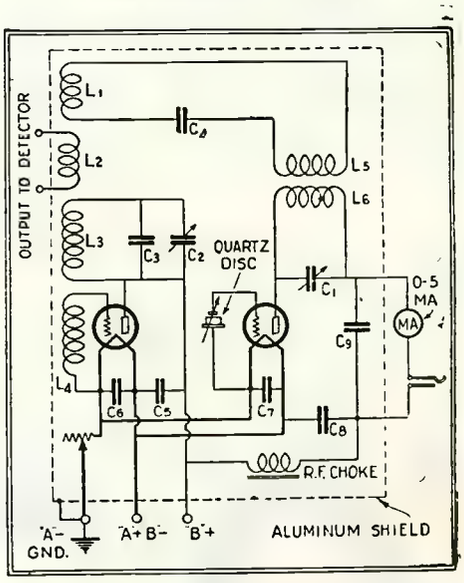
As a general rule the tendency toward oscillation is increased by low resistance, that is, by good design in the grid circuits. It is also increased by using large tuning coils with small condensers, although this is good practice. The tendency to oscillate is generally increased by close coupling in radio frequency transformers because the close coupling allows a greater transfer of power and increased signal voltage in the grid circuit. Loose coupling of the antenna circuit increases the oscillation tendency because the loose coupling removes some of the load from the grid circuit of the first coupled tube, or reduces the loss of energy from the coupled circuit into the antenna. Tube filaments lighted at normal brilliancy further increase the likelihood of oscillation. The tendency to oscillate is increased by increase of plate voltage. The higher the voltage the more easily will the circuit oscillate. Oscillation is increased by connecting two or more radio frequency or audio frequency stages to the same B-battery or power unit. Of course, this is the common practice. The reason for this increased oscillation is that the resistance of the common power supply forms a resistance coupling between the stages and there is a feedback of energy through this resistance coupling. The converse of all of the above causes of increased oscillation will naturally reduce oscillation.

### AUDIO FREQUENCY OSCILLATOR

(628) R. Plauser, Brady, Texas, writes:

Q. 1. Please publish a circuit diagram of an audio frequency oscillator using some method of stabilization, preferably a piezo electric crystal.

A. 1. The U. S. Bureau of Standards has done some valuable work along these lines and has constructed an audio frequency oscillator which uses a piezo electric quartz disk for control. On this page you will find a diagram showing the hook-up of the oscillator in question. A straight frequency line condenser is used for changing the frequency within the audible range and its scale is calibrated in audio frequencies. Final adjustments of frequency can be obtained by means of a hand control attached to the quartz disk. In the diagram, coils L1 and L2 are the oscillator coupler, L3 and L4, the intermediate frequency coils, and L5 is a pick up coil placed in proximity to L6. C2 has a capacity of .0007 mf. and C1 a capacity of .00035 mf., C5, C6, C7 and C9 are by-pass condensers, while C8 is a filter condenser. The apparatus is placed within a metal shield, preferably of aluminum. The outgoing audio current is produced by the interfering of two high frequency currents. The frequency is fixed by the dimensions of the quartz disk and its position in the holder. The particular oscillator shown here was designed to have a range from about 50 to 4,000 cycles. A thermostatic control is used for accurate work and a power amplifier can be used when a large amount of energy is required.




**An audio frequency oscillator with quartz crystal control is shown above. A straight frequency line condenser is used for changing the frequency within the audible range.**

# Scientific Humor

### NOT WORTH ITS SALT

ANGRY CUSTOMER: "I've brought back this vacuum cleaner."

APPLIANCE SALESMAN: "Why, you've only had it a week."

ANGRY CUSTOMER: "Well, you demonstrated how it would suck salt right through a carpet with dirt."

APPLIANCE SALESMAN: "Yes, we demonstrate that way."

ANGRY CUSTOMER: "Well, I can't afford the salt to clean my carpets."—*Leslie Carpenter.*

### NEW BRAND

MACK: "What kind of a car have you?"

BLACK: "I got a Wreck."

MACK: "A Wreck?"

BLACK: "Yeah, every time I park it, a dozen people come up and ask me if I've reported the accident yet."

—*William Lesser, Rep. No.* 31,587.

### CAUSE IT TAKES A MAN TO MANAGE HER

PROF: "Why is a ship always called 'she'?"

STUDE: "Probably because the rigging costs more than the hull."

—*Whitmore Melcher.*

### WARNING

DING: "What kind of radio have you got?"

DONG: "The railroad type—whistles at every station."—*Clifton Ask.*

### HE FOUND OUT

"I heard the butcher cut his finger slicing bologna."

"How come, trying to slice it too thin?"

"No, he forgot to get the bologna."

—*Edward Raible.*

### FROM FIZIX EXAM

Define a cell and a photometer.

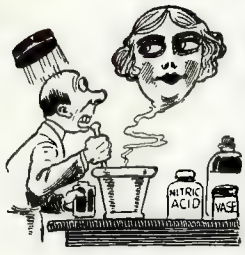
A cell is a mass of protoplasm containing one or more nuclei. It may be also defined as a small room in a prison.

Photo means picture and meter means measure—therefore photometer is an instrument for measuring pictures.

100% —*Querubin Fulgencio.*

**FIRST PRIZE $3.00**

### EXACTLY




INQUISITIVE STUDENT: "Just what is modern beauty?"

CHEMISTRY PROF.: "A mixture of red lead, oxide, petroleum greases, henna, cellulose products, wood pulp, nitric acid, and dyes."—*Bruce M. Metzger.*

### O I S Q?

A B: O J K C D Y L S
J K: O L L M O Y L S
A B: O I C S A R A D O
J. K: S A Y L S R A D O

—*Leslie Carpenter.*

*ALL jokes published here are paid for at a rate of* $1.00 *each;* $3.00 *is paid for the best joke submitted each month.*

*Jokes must have a scientific strain and should be original.*

*Write each joke on a separate sheet of paper and add your name and address to each.*

*Unavailable material cannot be returned.*

### GUARANTEED RESULTS

When the doctor made his call on the patient the next morning he was quite surprised to hear groans and moans from the sick room.

"How are you feeling this morning, Jim?" asked the doctor cheerfully, although inwardly he was raging at the sight of the almost untouched medicine bottles.

"Oh," groaned Jim, "I am in pain, terrible pain. I wish that providence would have mercy on me and take me out of this."

"How can you expect it," asked the doctor, "if you don't take the medicine I give you?"—*M. M. Raub.*

### BUGGY ACID

When they take up the rugs next spring there will be a lot of holes in them that will be blamed on the poor little moths, when deep down in some men's hearts they will know they set a leaking radio battery on the rug.—*Donald Petering.*

### PHENOMENAL

JOHN: "Mary, I saw a woman out here with one side of her face perfectly black."

MARY: "What could have been the cause, do you suppose?"

JOHN: "I don't know what caused it, the other side was black, too."—*Beryl Stemple.*

### CONCLUSIVE PROOF

YOUNG LAWYER: "Your honor, I claim the release of my client on the grounds of insanity, he is a stupid fool, an idiot, and he is not responsible for any act he may have committed."

JUDGE: "He doesn't appear stupid to me."

PRISONER (interrupting): "Just look at the lawyer I've hired, your honor."

—*Ollie Meloay.*

### WHAT WAS HE—ANIMAL?

The discoverer of ether as the producer of unconsciousness was William Thomas Green Morton, a Boston dentist, who had experimented for nearly two years in using the fumes upon animals and upon himself, before he ventured to try it in practice and upon a human being.—(*Editorial N. Y. Telegram.*)—*Maurice Blank.*

### THAT COLD WORN LOOK

FIRST ROCK: I tell you there's nothing like contact with a glacier to take off the rough edges and make you an all round rock.

SECOND ROCK: Yes, it's made me a little boulder already.

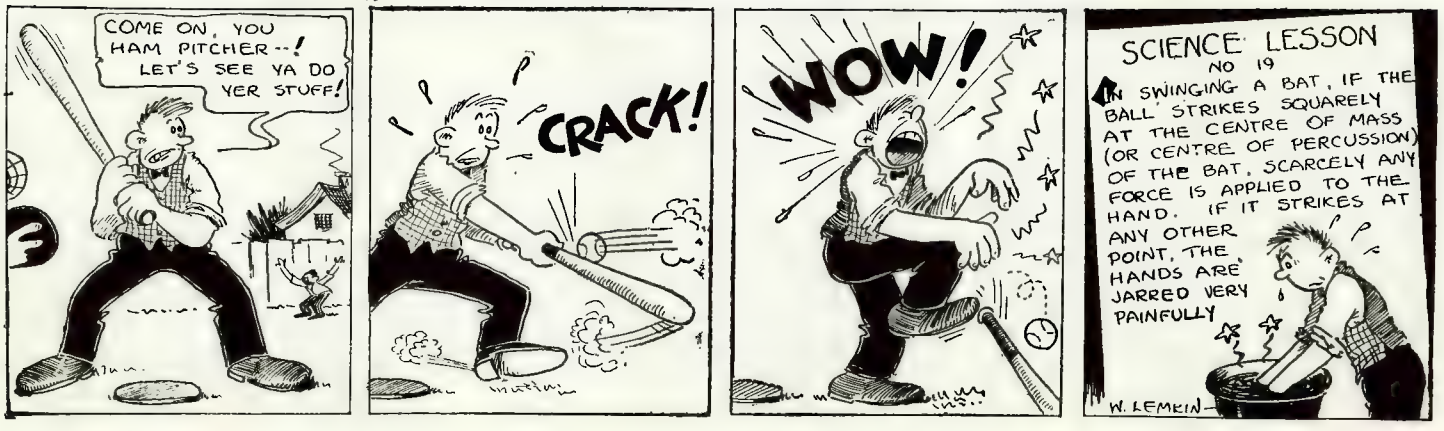
—*Gleason Pease.*

### MUSIC MEDICAL

RADIO LOUDSPEAKER: "—and all medical authorities recommend Dr. Flooy's formula for ailments of the heart, lungs, stomach, liver, kidneys, intestines, pancreas, gallbladder, thyroid gland, oesophagus, and vermiform appendix!"

RADIO LISTENER: "Ah—an ORGAN RECITAL!—*William Lemkin.*

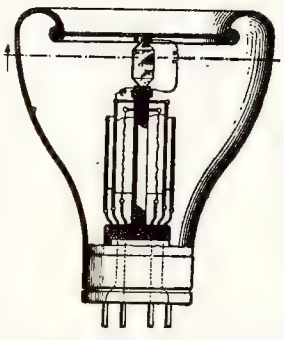
## SCIENTY SIMON, Scientist


COME ON, YOU HAM PITCHER--! LET'S SEE YA DO YER STUFF!
CRACK!
WOW!
SCIENCE LESSON NO 19
IN SWINGING A BAT, IF THE BALL STRIKES SQUARELY AT THE CENTRE OF MASS (OR CENTRE OF PERCUSSION) OF THE BAT, SCARCELY ANY FORCE IS APPLIED TO THE HAND. IF IT STRIKES AT ANY OTHER POINT, THE HANDS ARE JARRED VERY PAINFULLY
W. LEMKIN

## RADIO SPEAKING DOLL

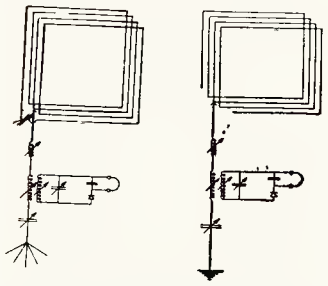
No. 1,652,839, issued to Norman C. Smith. The doll shown here has a fabric body, in which is concealed a radio loud speaker. Tip jacks are provided for connecting the speaker to the radio receiver.

## PIEZO AUDION



No. 1,636,921, issued to Alexander McLean Nicolson. The audion shown above, comprises an evacuated envelope in which are placed a grid, filament, plate and a piezo-electric crystal element.

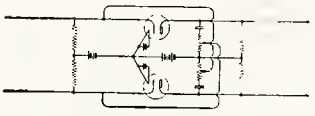
## ANTI-STATIC AERIAL



No. 1,639,913, issued to Roy A. Weagant. This aerial comprises two collecting portions which form a single antenna, one is an open loop, and the other a vertical antenna connected to the mid tap of the loop. The radio circuits are coupled to the vertical antenna. Two forms are shown above.

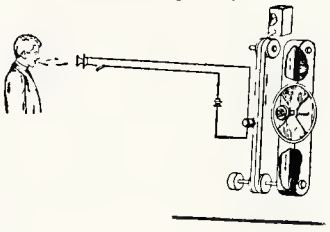
## AMPLIFYING CIRCUIT

No. 1,647,216, issued to Lloyd Espenschied. This amplifier is designed to be used with radio receiving apparatus and provides a means for varying the amplification for different amplitude values of the incoming signal. A feed-back connection between the input and output circuits provides for controlling the degree of amplification. The apparatus is designed especially for the amplification of weak signals, such as those received across the ocean.



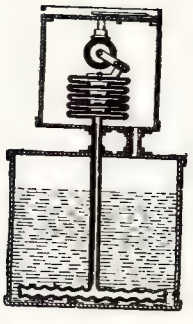
## TELEVISION APPARATUS

No. 1,634,571, issued to Rudolph A. Dallugge. The mechanism shown here comprises a transmitting and receiving device and a means for synchronizing. A selector member connected to each of the devices periodically, causes light rays to move transversely across a synchronizing zone. The photo-electric cell at the receiving end responds to these light rays.

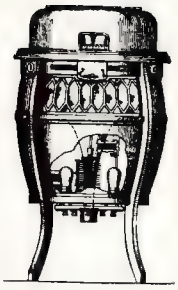


## GAUGE FOR LIQUIDS

No. 1,661,995, issued to Kirk Brown. This gauge for liquids consists of two movable members, one of which has a definite zone of travel at a given temperature, and is adapted to be actuated by the static pressure of the liquid. A means is provided for affecting the other member by the actuated member when due to a change in temperature the latter member travels beyond either terminal of its normal zone. An indicator has been provided which moves over a scale on the top of the device.

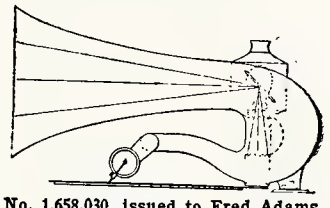


## RADIO PHONOGRAPH



No. 1,656,085, issued to James S. Spainhour. This invention is a combination of radio-phonograph consisting of a phonograph unit housed in the same cabinet with a radio receiving set. A revolving table is provided for the phonograph records and can also be used as a dial in conjunction with the radio set. It is operated by a motor when using the phonograph, and manually operated when used as a dial. A means has been provided for cutting in or out the record table according to its use.

## PICTURE EXHIBITOR FOR TALKING MACHINES



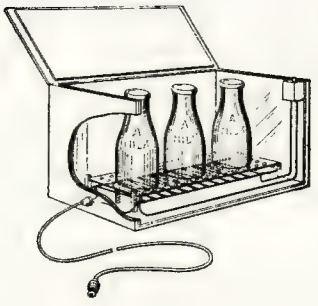
No. 1,658,030, issued to Fred Adams. This picture exhibitor for disc record talking machines has a slip disc slotted to expose sound grooves and provided with a marginal row of pictures. A baloptican picture projector is carried by the tone arm. The pictures are thus exhibited in synchronism with the sound reproductions.

## CIRCUIT CLOSER FOR ELECTRIC ALARMS

No. 1, 657,459, issued to Frank Davis. This alarm system has an alarm circuit which is closed by a specially designed circuit closer. The circuit closer is worn on the leg and is operated by the other leg. A floor cord connecting the circuit closer with the alarm circuit, permits a limited amount of movement.

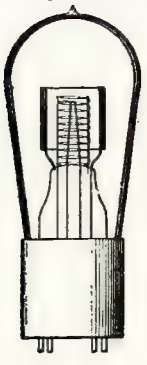
## ANTI-FREEZE CONTAINER

No. 1,661,354, issued to William W. Ayre. The antifreeze apparatus shown here is closed against the admission of air and contains a thermostatic circuit closer, which breaks the circuit when the temperature in the container rises to a predetermined point; and closes the circuit when the temperature again falls.



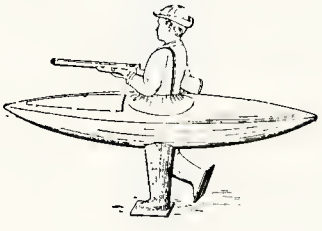
## ELECTRON TUBE

No. 1,653,544, issued to Hugh Alexander Brown. The tube shown below contains the usual three elements and has a stable filling of free alkaline metal, which is a molecular alloy of sodium and potassium. When using this alkaline tube, low plate potentials may be used, and at the same time the sensitivity is increased.

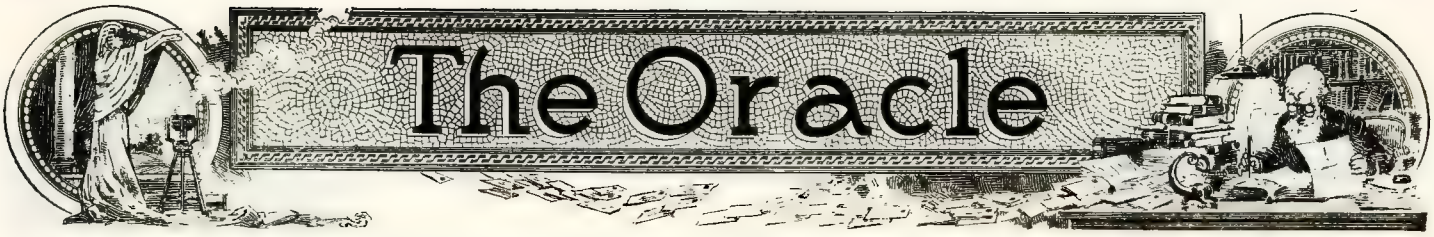


## HUNTING BOAT

No. 1,657,786, issued to Cecil C. Carmichael. This boat structure is provided with leg holes and water tight sleeves to fit over the legs, so that the hunter may propel himself in the water. The boat has a number of separate water tight compartments and may be tightly laced around the waist of the wearer.



NOTICE TO READERS: The above illustrated and described devices have recently been issued patent protection, but are not as yet, to our knowledge, available on the market. We regret to advise that it is impossible to supply the names and addresses of inventors of the above devices to any of our readers. The only records available, and they are at the Patent Office at Washington, D. C., give only the addresses of the inventors at the time of application for a patent. Many months have elapsed since that time, and those records are necessarily inaccurate. Therefore, kindly do not request such information, as it is practically impossible to obtain up-to-date addresses. —EDITOR.



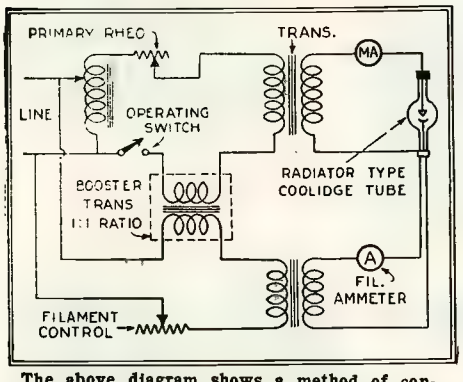

The "Oracle" is for the sole benefit of all scientific students. Questions will be answered here for the benefit of all, but only matter of sufficient interest will be published. Rules under which questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink; no penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addressed to this department cannot be answered by mail free of charge.
4. If a quick answer is desired by mail, a nominal charge of 50 cents is made for each question. If the questions entail considerable research work or intricate calculation, a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

### CONTROLLING X-RAY VOLTAGE

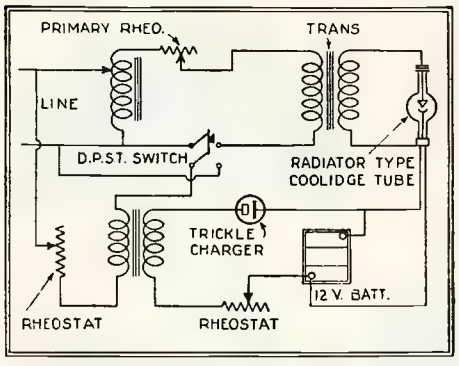
(2253) W. A. Helm, U. S. Naval Hospital, Portsmouth, Va., asks:

Q. 1. Will you kindly advise me of a method which I can use for satisfactorily controlling the filament voltage delivered to a Coolidge X-ray tube of the radiator type? Due to line fluctuations in this locality, the voltage changes quite frequently.




**The above diagram shows a method of controlling X-ray tube-filament voltage by using a booster transformer having a 1:1 ratio. This transformer has a low resistance winding in both circuits.**

A. 1. On this page you will find illustrated two diagrams showing how fluctuations in line voltage can be compensated for when using the X-ray outfit. For A.C. use, it is best to use a stabilizer which several companies manufacture expressly for keeping the filament voltage constant. Another method is that which was used in the U. S. Army Mobile X-ray Unit, wherein a booster transformer was connected in the circuit as shown. The ratio of this transformer is 1:1 and has a low resistance winding in both circuits. A 12-volt storage battery can be used for this work with an automatic switch and relay, to cut in a trickle charger for the battery when the unit is not in operation. This method is shown in the diagram appearing here, and will effectively eliminate the troubles due to line fluctuation.




**A twelve-volt storage battery with an automatic switch and relay and trickle charger, can also be used with the tube, as shown above. In this way the filament voltage is kept constant at all times.**

### SEA-SICKNESS REMEDY

(2254) B. W. Rae, Camden, N. J., asks:

Q. 1. Can you give me the formula for an effective remedy for sea-sickness?

A. 1. There has recently been patented by Garrett N. Banker, a ship physician and surgeon, an effective medicinal preparation for the alleviation of sea-sickness. The relative proportion found desirable to use per dose are as follows:

Scopolomine 1/400th gr.
Ethylmorphine hydrochloride 1/8th gr.
Strychnine sulphate 1/120th gr.
Cerium oxalate, 2 to 4 grains

The ingredients are prepared in dry powdered form, are then mixed together and enclosed in a gelatin capsule in quantities to provide a dosage of desired strength. When using this composition as a remedy for sea-sickness, one dose is generally sufficient to restore the patient to normal. Strychnine sulphate is a virulent poison.

### DESTROYING BEETLES

(2255) H. J. Livingson, Ft. Worth, Texas, asks:

Q. 1. Do you know of an effective way for combating the common larder and drug store beetles?

A. 1. The adult larder beetles are easily seen and may be caught one by one. In cases where they are not too abundant, this method of control is probably the easiest way of dealing with them. The beetles are very fond of cheese, and by exposing pieces of it, they will congregate on them and may be caught and killed in considerable numbers. If this method is followed up carefully for several days, it may often prove to be effective. If the beetles are abundant and there are many hiding places in the room, the room should be entirely cleared of food products, then thoroughly cleaned, and finally sprayed with boracic acid solution. Cheese ground up and poisoned with arsenic will often kill many of these pests.

The drug store beetles usually get into the house with some article of food which has been brought from a store. Where they occur in a sack or barrel of meal or flour, they will usually be found near the top; in this case, the top portion may be removed and the beetles gotten rid of in this way. If the cereal is infected with these insects, it is best to kill them by fumigating with carbon-disulfide, to make sure that none of them escape and infest other household materials. This may be done by setting a cup of the liquid on top of the flour in a tin dish and covering the barrel tightly. Allow it to stand for three or four days, so that the gas can penetrate the flour. Do not go near the barrel with a light of any kind, as the carbon disulfide gas is inflammable and explosive when mixed with air.

### FLOOR PAINTING

(2256) B. Spinoza, Geneva, New York, asks:

Q. 1. What is your opinion of a good type of floor paint?

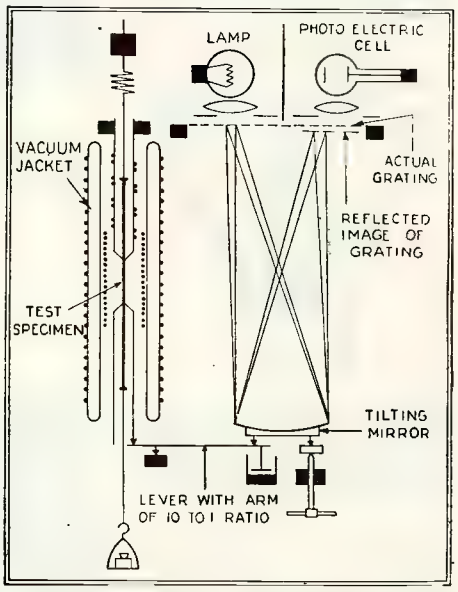
A. 1. The best floor paint has a very elastic varnish for the carrying medium. It is necessary that the floor paint dry hard and quickly, for a number of reasons. By the use of varnish, a floor paint can be made which will dry within 12 or 24 hours, and which will be waterproof and glossy. Ordinary oil paint to which driers have been added, is so much affected that it is not as durable as it should be. If turpentine is added, it diminishes the necessary amount of binder. "Floor paint hardeners" should not be used; they usually consist of cheap rosin varnish loaded with driers. No rosin varnish should be used on any of the woodwork about the house, least of all on the floor. The best of such varnishes contains about 20 gallons of oil to 100 pounds of rosin. It will need some drier, more than the ordinary interior varnish, but its quick drying should not be obtained by diminishing the amount of oil or the paint will chip and flake off. Ordinary paint can be used on the floor, but it should be allowed at least two months to dry.

### MEASURING ONE-BILLIONTH OF AN INCH

(2257) J. B. Carmichael, Syracuse, New York, writes:

Q. 1. Will you please outline briefly, the method used by the Bell Telephone Labs. in measuring one-billionth of an inch and publish a drawing of the apparatus if possible.

A. 1. On this page you will find illustrated the mechanism used to measure one-billionth of an inch. The equipment was originally designed to measure changes in length in a piece of wire about four inches long. One end of the four-inch section is fixed in position, and to the other end, a clamp is attached which connects to the short arm of a lever. The long arm of this lever tips a concave mirror as the wire changes its length. Light from an incandescent lamp, after passing through a lens so as to give a beam, falls on the mirror at a small angle from the perpendicular, and is reflected back to a position somewhat offset from the lamp, where a photo-electric cell is mounted. Between the light




**The mechanism used to measure one-billionth of an inch is shown above.**

source and the mirror is a grating with alternate opaque and transparent lines each half a millimeter thick. The image of this grating falls on the mirror and is reflected back to an extension of the same grating in front of the photo-electric cell. When the images of the transparent lines are reflected back to another group of transparent lines, full light will fall on the cell. When, on the other hand, they fall on the opaque lines no light will be transmitted. Only a very small movement of the mirror is required to cause this change from full light to no light. The photoelectric cell passes a current proportional to the light falling on it, and this current is indicated by a sensitive galvanometer. The galvanometer indication thus serves to divide the width of one bar of the grating into a large number of smaller divisions.

As imperceptible temperature changes cause expansion sufficient to tilt the mirror, every precaution is taken to keep the temperature of the wire constant. It is surrounded by a vacuum cylinder like the packet of a thermos bottle, with an opening at each end, and in addition, a special electrical compensating coil is used to maintain constant temperature. The entire equipment is mounted on a spring suspension so that vibrations of the building will not affect it.

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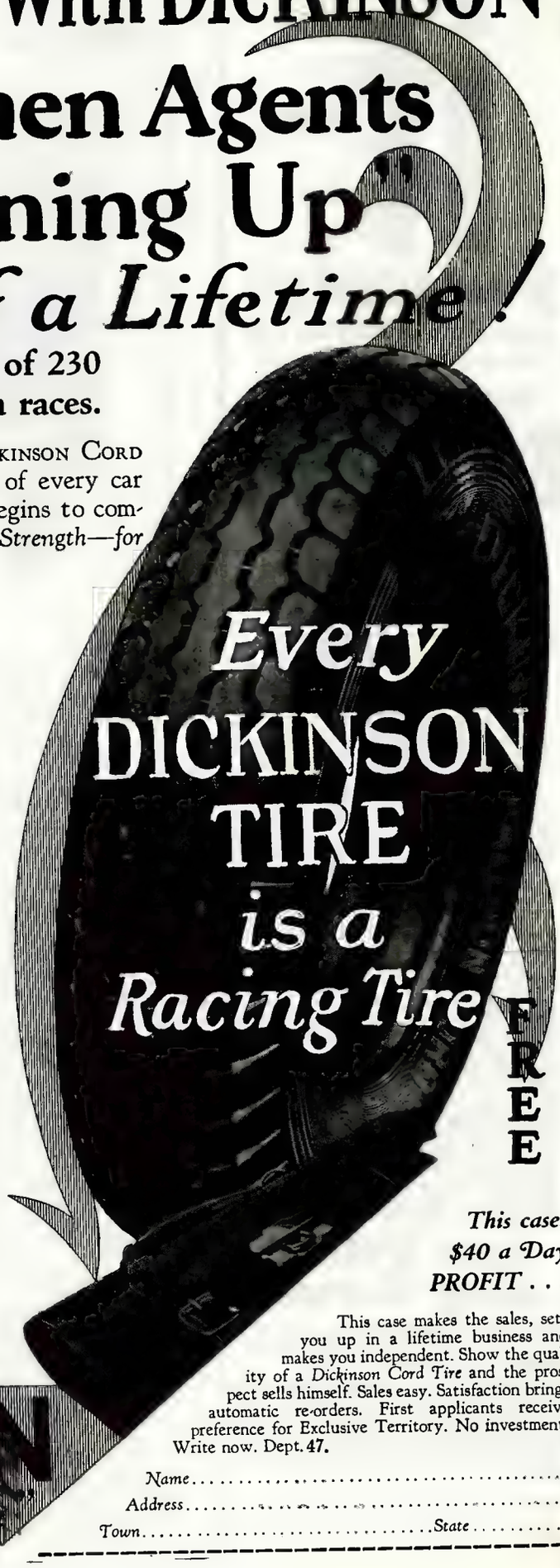


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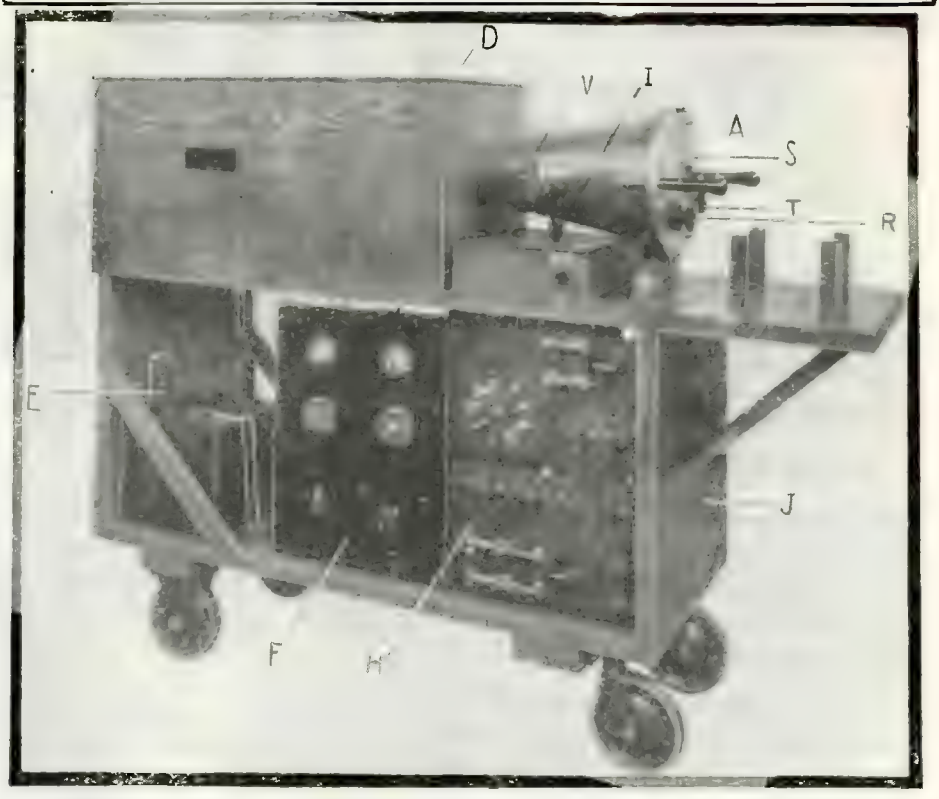
# HARNESSING NATURE'S ELECTRICITY

By HENRY TOWNSEND

(*Continued from page* 111)




**Remarkable cathode ray oscillograph used by Mr. F. W. Peek, Jr., in causing lightning to write its autograph with a pencil of electrons on a photographic film.**

easily be 100,000,000 volts, as Mr. Peek has pointed out in one of his scientific papers.

### WHY THE EXPERIMENTS ARE BEING MADE

ONE of the main reasons why these dangerous experiments are being carried on by the three young German scientists, whose names we have already learned, is because science believes that with a sufficiently high voltage, it will be possible for man to disintegrate the atom, and in this way make available a tremendous source of power as yet untapped. These experts have calculated that they will be able to obtain electrical energy in sufficient quantity from one of these powerful atmospheric discharges, to equal the Alpha rays obtained from 220 pounds of radium. As we have mentioned before, these experiments are of course fraught with great danger, and for that reason the experimenters seek refuge in a special lightning-proof hut, which is located about 600 ft., from the spark gap. When electrical storms are in the vicinity, it is especially important that the scientists keep within their protected fortress, for otherwise they would very probably be killed by a stray electrical discharge.

One of the peculiar things about this whole line of experiment is that the average layman does not realize perhaps, that there is a high electrical stress in the atmosphere on clear days, as well as when thunder storms are overhead. This fact has been known for a hundred years and more, and many years ago measurements of the various electrical potentials at increasing altitudes, were observed and measured by scientific investigators. There are a number of different ways in which these high electrical potentials found in the atmosphere can be measured; one of these methods involves the use of a calibrated spark gap. In this case the gap is set to a predetermined length, and when a discharge jumps this gap, the engineers know of course from previous experience and measurements, just what voltage is present. Another method of measuring extra high potentials, such as here encountered, requires the use of a static voltmeter, which involves the use of a stationary and of a movable or rotary set of metal plates, forming a condenser, to which an indicating needle is attached. For voltages above 2,000, static voltmeters have been used in a great many American central stations, and they have many desirable and useful characteristics. Of course as the voltage to be measured increases, the space between the quadrant shaped stationary and movable plates is increased and vice versa. The electrostatic field from voltages below 2,000 is not sufficient to warrant the use of a static voltmeter. Another method of measuring high potentials involves the use of the so-called vacuum tube voltmeter.

The general characteristics of the atmospheric electrical discharges, including lightning, have been measured and recorded by one of the newest scientific instruments, known as the cathode ray oscillograph. By means of this quite remarkable, high voltage scientific apparatus, Mr. Peek, one of the well-known General Electric Company staff of research engineers, has made some very interesting and remarkable discoveries concerning the nature of natural electrical discharges, particularly of lightning discharges. Many people will probably wonder why Mr. Peek and some of his colleagues in the engineering profession, including the three daring German students, Messrs. Brasch, Lange and Urban, play with such dangerous electrical discharges, and why they are at all interested in them. We explained previously why the German savants are intent on finding out all they can about these tremendous voltages obtained from the atmosphere, while Mr. Peek, we may say, also has a very practical reason for carrying on experiments with these death-dealing bolts of Thor. Mr. Peek has been for many years intent on finding out what causes the huge insulators on long distance, high potential transmission lines to break down when electrical storms break loose over these regions.

## Giant Lizards of Today and Yesterday

By JOSEPH H. KRAUS

(*Continued from page* 105)

Island of Komodo, the chances are that the animals do not die frequently enough to supply food for all of the Komodo lizards.

It does not take much of a stretch of the imagination to realize that these 9 foot giant lizards of today, as described in the G. P. Putnam's Sons publication, previously mentioned, are but the descendants of the lizards that invaded the world about sixty million years ago, lizards whose fossilized remains are 160 feet long. The reptilian age existed long before the mammals which arrived in the eocene or "dawn" age, at a time when this earth was covered with swampy vegetative land. These reptiles when walking through the soft clayey soil left the imprints of their feet in the ground and these same imprints can today be seen at the various museums permanently inscribed in rock. Dr. Daude located trees with a diameter of 575 feet, if the reports are correct, and with a length of from 1200 to 1500 feet and a bark that was 28 feet thick and which had become completely silicified after the many natural changes which take place. It might be here stated that many scientists doubt the accuracy of the reports.

Pseudo explorers have often claimed that in the interior of Peru, some of the now extinct mammals still roam at large in secluded areas encircled by unscalable mountainous precipices, but were this true, it is very probable that the evidence would have reached our naturalists long before this time, and we all would have had unmistakable proofs of these monster lizards.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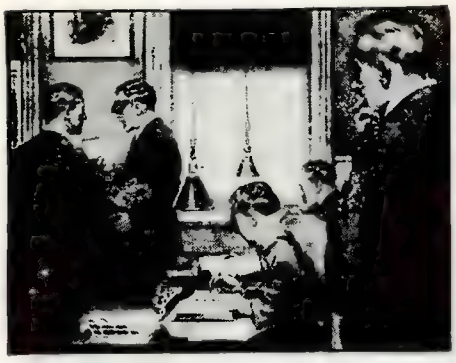

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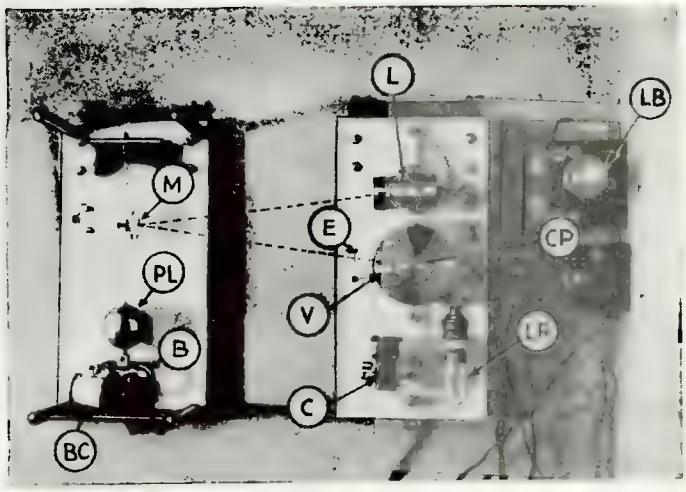
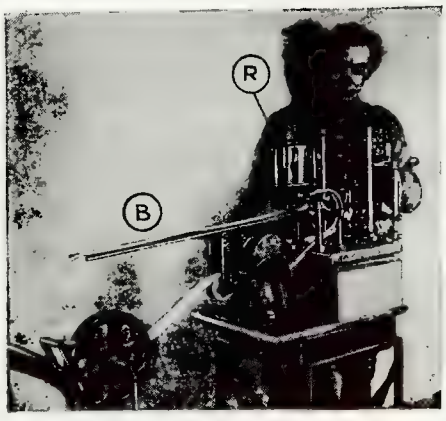
(*Continued from page* 121)




**At the right is a photograph showing the free pendulum and the photo-electric equipment. M is a mirror, PL, the free pendulum; B, a magnetized bar; L, an ordinary lamp; E is the diaphragm, V, a shutter placed in the line of the reflected light ray; C, the shutter control; CP, photo-electric cell, and LR, lamp resistance. This self-regulating clock is extremely accurate and can be used in determining the longitude of any place with a very small possible error.**

does not act now upon the photo-electric tube. No current can circulate in the circuit. To determine the regularity of the pendulum's action, the following process is employed.




**The above photograph shows, at B, the paper strip, and the water reservoir at R.**

A paper band blackened with lamp black is placed beneath it, as it moves at the rate of two inches a second, and passes under two styluses. One of these styluses is driven by an electric tuning fork kept in motion electrically at fifty beats a second, which stylus gives a sinuous very regular trace on the paper, on which, if fifty of the wave line curves are counted, it gives us a period of a second. Thus the regularity of the pendulum beats can be determined

Errors will be reduced to a minimum and we will not see, due to longitude errors, part of the course of a river important for navigation, or a rich mine of metal ore attributed to one nation, when it reality it ought to be located on the neighboring territory. Again, it gives a possibility of obtaining confirmation of certain theories like that of Vegener, for example, to see if this curious phenomenon exists, which should be the change of continents, and on which we do not possess now any certain data.—*Lucien Fournier.*

## EXPERIMENTING WITH NEON LAMPS

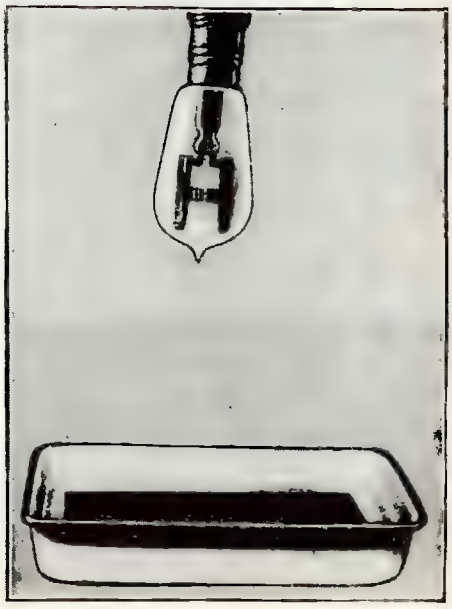
(*Continued from page* 138)

By RAYMOND B. WAILES

plied. If a variable condenser (0.1 to 1.0 mf.) is placed in series with a variable resistance (about 10,000 to 500,000 ohms) and a source of current, say 220 volts, or the output from a B eliminator, and a neon lamp is shunted across the condenser of this circuit, the lamp will light at intervals from once in ten minutes to many thousand per second, depending upon the resistance of the resistor and the capacity of the condenser.

The writer suggests that the experimenter try to limit the current through a neon lamp by placing resistances in series, so that the lamp will not light. Several telephone receivers of high resistance will not be sufficient and it is only when grid leaks of low values are used that the lamp will not light. As an experiment, try several feet of distilled water in glass tubes.

One peculiar feature of a 110-volt lamp used by the writer was that of a lamp in a lamp socket with the current turned off through a switch in one side of the wiring. The lamp was then "out." On bringing a hand up to unscrew the lamp from the socket it would light faintly but distinctly, the glow creeping over the electrodes as the hand was wiped about on the face of the glass bulb.



**Some neon lamps can be used in photo dark room.**

## Phoney Inventions

By HUGO GERNSBACK

(*Continued from page* 113)

usual announcement formality is over, the entertainer begins to sing or recite in the usual solemn fashion over Station WXYZ facing the microphone. The perpetrator of the trick then presses a release at the bottom of the stand, when a colored snake suddenly pops into the singer's or performer's face, much to the hilarity of the audience. Of course this fake microphone may be fixed in some other way if the trick snake is not wanted. The microphone shell can be provided with a powerful spring inside and when the release catch is depressed, the whole microphone will fly to pieces in all directions. The performer can then be told that his or her voice was not suited for radio transmission and that he or she burst the mike.

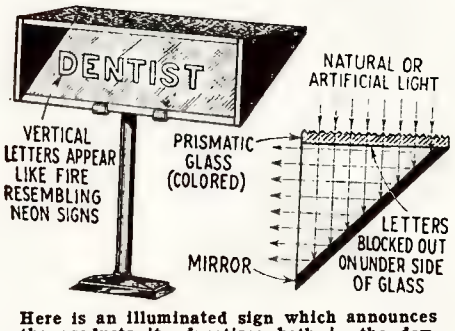
### CIGAR LIGHTER

A TRICK that will never fail to provide a good deal of amusement is easy to make. All you require is a cheap pocket lighter, and the part that usually holds the wick should be drilled to make it larger. Then, you will find, it is large enough to hold a safety match. The bottom of the lighter is then provided to hold an ordinary match scratching surface, which you may take from an ordinary match box. It should be cut to size and then shellacked or glued to the bottom of the lighter.

After the device has been completed, you announce to your friends that here at last is a lighter that works at all times. You explain to your friends that *their* lighters usually do *this*, then revolve the little wheel, which will give off some futile sparks, inasmuch as you did not remove the cerium iron which makes the sparks. You then say that *your* lighter ALWAYS works. Quickly you pull out the match and strike it on the scratching surface on the bottom of the lighter. A new match can then be put in to surprise some other friends later on. This particular device never fails to provoke a hearty laugh on account of its foolishness. That, by the way, is the secret of all of these Phoney Inventions. The more ridiculous, the more foolish, the more useless the device is, the more mirth-provoking it will be.

In our next issue I shall give more information about Phoney Inventions which I also used at various occasions, after which I hope that a sufficient number will be received from our readers to keep this new department going for a long time.

## DAY AND NIGHT SIGN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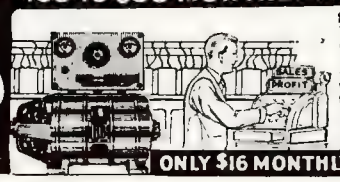

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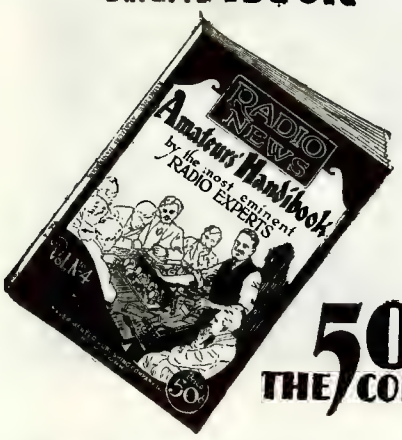


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## BOOK REVIEW

PEGASUS, or Problems of Transportation, by Colonel J. F. C. Fuller. Stiff cloth covers, 4½" x 6¼", 88 pages. Published by E. P. Dutton & Co., New York City. Price, $1.00.

In this book, the author gives us an account of the evolution of travel, and of the discoveries and inventions which have aided the problem of transportation. The first part of the book is devoted to the battle of the "Iron Horse," and gives a stimulating account of the first locomotive steam engine. Another portion of the book is devoted to methods of improving the efficiency of tracked vehicles, which is a clear discussion of this subject, as given before the Institute of Engineers. Another very interesting portion, is that entitled "Transportation in Tropical Africa," which has been republished in this valuable little book. Colonel Fuller, when speaking of the present problems of transportation, claims that the tracked vehicle will dispense with roads, and is the solution of the unemployment problem, means of exploring new lands, rich in mineral resources, and the means of preserving order and peace, without a large military reserve.—*P. L. W.*

AERONAUTICAL METEOROLOGY, by Willis B. Gregg, stiff cloth covers, 6" x 8½", 156 pages, illustrated. Published by Ronald Press Co., New York City. Price, $2.75.

For the successful development of aeronautics, a knowledge of the characteristics of the atmosphere has been recognized as indispensable. The aeronautic engineer should have at his command, information regarding the difference in the density, pressure and temperature at various heights. The pilot should know the variations in direction and velocity of wind with changes in altitude, the average height of the different types of clouds and many other details concerning atmospheric conditions. The purpose of this book is to supply this information, to give the essential facts of the upper air, and to point out the relation of the characteristics of the atmosphere to aeronautics. Although there are many excellent books which treat on general meteorology, they do not contain the information needed by the airman, and usually have material of interest only to the professional meteorologist. In this book, however, the latter type of information has been included only where it is necessary to give a general ground work for the better understanding of atmospheric characteristics and conditions related to aeronautics. The book is profusely illustrated with graphs, weather maps and photos, in order to give a complete understanding of the text. The need is being felt for progressive literature concerning aerial navigation, and this book which is but one of a series, should be read with interest by the aeronautical engineer and pilot.—*P. L. W.*

THE BROTHERHOOD OF THE SEA. By E. Keble Chatterton, 8¾ x 5½ inches. Cloth binding. 239 pages. Illustrated. Published by Longmans, Green and Co., Ltd. New York. Price $3.50.

No matter whether one has never been near a body of water larger than a pond or whether one has been at sea all his life, there is a charm and fascination about stories of the sea that have an universal appeal. Moreover, when the yarns are about the deeds of brave men—and where can braver be found than on ships?—then the appeal is intensified, because everybody longs to do brave deeds and if they can not do these deeds then they like to read about them.

Someone has truly said, "Truth is stranger than fiction" and this is borne out when one reads of the acts which were performed by men of the real he-variety in Mr. Chatterton's book. Nowhere do we know of a place where men's courage is tried oftener than on the sea and the author, starting back in the days of sailing ships, traces this bravery down to the rescue of the crew of the *Antinoe* by the brave men of the *President Roosevelt*. Breath-taking stories of risks taken as a matter of course during the World War by naval men are related and any one of them told separately would make the average landlubber wonder how men could deliberately do such things.

To our mind it is books of which this is an excellent example that should be put in the hands of the younger generation for reading. From *The Brotherhood of the Sea* will be gained a picture of how real men act when under stress; how brave men have gone on acts of mercy knowing full well that they had only the remotest chance of returning alive; how men during wars have done their duty in the face of dangers that were appalling, in short how men should behave, but how only too few do. Books of this kind we recommend not only for the sake of a rattling good tale well told, but for the reasons that we have set forth above.

*G. C. B. R.*

CALLENICUS, by J. B. S. Haldane. Stiff cloth covers, 4½" x 6½", 84 pages. Published by E. P. Dutton & Co., New York City, New York. Price, $1.00.

Chemical warfare will not assume importance until the outbreak of the next serious war. The average person still thinks about it as he did during the great war, and a large portion of his opinions were formed by what was printed in the newspapers, at that time. The author does not believe that war is over, and claims that the next war will be one of poisonous gases and smoke. He analyzes the objections of pacifists, and soldiers to the new weapons of chemistry, and in short, gives a defense of chemical warfare. The book is a stimulating work which has been written by Mr. Haldane, a famous chemist who has had practical experience in warfare.—*P. L. W.*

PYGMALION, or The Doctor of the Future, by R. M. Wilson, M.B., Ch.B.. Stiff cloth covers, 4½" x 6¼", 68 pages. Published by E. P. Dutton & Co., New York City, New York. Price, $1.00.

In this small volume, the author draws an encouraging picture of what the doctor of the future will be, and what he will undoubtedly accomplish in the way of cures. He not only points out the value of a recent theory, that so called "symptoms" are not necessarily a sign of a disease, but also relates some of the remarkable cures that have been effected by application of this theory. The book also states what the physician can do to help the patient cure himself, giving the new psychology of the doctors' attitude to health and disease. The book will furnish a great deal of food for thought, and goes directly to a problem of much importance. This subject, concerning the doctor of the future, has been discussed in interesting and non-technical language, so that anyone can understand and profit by reading it.—*P. L. W.*

WIRELESS DIRECTION FINDING AND DIRECTIONAL RECEPTION, by R. Keen. Stiff cloth covers, 5¾" x 8"½, 490 pages, profusely illustrated. Published by Iliffe & Sons, Ltd., London, England.

Since the early days of wireless telegraphy, directional or beam transmission has been a subject of much interest to experimenters the world over. Quite early in the art, it was realized that if radio transmitters or receivers could be given accurate directive properties, the scope of radio communication could be extended, and the position of a transmitting station found by purely radio means. These directive properties are discussed and analyzed in this comprehensive volume, on radio direction finding and directional reception. The author deals in particular with problems affecting position finding and navigation. Further information is included, regarding the closely allied subject of directional reception for the elimination of atmospherics and of interference from other stations. Following a short historical survey of the subject to which Hertz and other early experimenters had directed attention, Mr. Keen devotes chapters to the directional properties of the aerial system, loop aerial reception, direction-finding installations, and to several systems of direction finding. Many other important aspects of the subject are dealt with, such as, suitable installation for work on shore, on ship and in the air. Night effect and other freak phenomenon, fault clearing and maintainance, and notes on field and nautical astronomy have also been added. The volume is completely illustrated with diagrams, drawings and photographic reproductions, in order to make the text thoroughly understandable.—*P. L. W.*

OUR MOBILE EARTH, by Reginald Aldworth Daly. Stiff cloth covers, 6" x 9", profusely illustrated, 326 pages. Published by Charles Scribner's Sons, New York City. Price, $5.00.

On the title page of this book appears a clever motto: "E pur si muove!" (And she does move), which has been attributed to Galileo. The idea of this book is to show how our earth is, by no means, a firm and motionless body, but in a sense, is like a mass of jelly. The earthquakes that are all too frequent, tell us in an unpleasant way how unstable it is. The book is fully illustrated and is written in a thoroughly readable style. The outflow of lava through its surface, for instance, is a good bit of characterization of the lava flows of volcanos, the effervescence of lava which makes it so spongy, producing as one of the well-known extremes, pumice-stone, while, when there are no gases, the beautiful obsidian results. It is not too much to say that illustrations are one of the best parts of the book which we take pleasure in recommending to our readers. A very nice bibliography fills several pages and we would especially call the attention of our readers to the index, nearly fifteen pages of fine type; a model and example for publishers and authors of scientific books. The making of this index must have been a labor of love with the author, and we wish that his example could be followed by many others.

(*Continued on page 172*)

## Of What Cloth is Your Suit Made?

By EDNA R. HAMBURGER, Ph.D.

(*Continued from page* 139)

in 150 cc of water. Add 10 grams of glycerine and stir thoroughly. Add gradually a solution of sodium hydroxide. A pale blue precipitate immediately forms. Continue to add the sodium hydroxide. After a while the precipitate originally formed seems to be dissolving. Continue to add the sodium hydroxide solution, stirring constantly until the precipitate originally formed is entirely redissolved. Avoid an excess of the alkali. Do not heat the solution. Silk will dissolve in this solution after standing twenty minutes at room temperature.

### MICROSCOPE REVEALS ODDITIES OF CLOTH FIBERS

When we turn to the cellulose group of fibers—rayon, linen, cotton, the matter of identification is indirect rather than direct, for there is no one chemical test which will state definitely that this particular thread is cotton, linen or rayon. Indeed, it is the microscope which offers the most definite evidence (See figures). Seen under the latter, a thread of cotton is transformed into a band of twisted ribbon. A thread of linen resembles a bamboo stick, its long straight length being broken by irregularly spaced nodules. Wool reveals the presence of a large number of overlapping scales resembling fish scales very closely. Both pure silk and rayon seem to be straight, transparent tubes. A thread of rayon is much thicker than one of pure silk, however, and is frequently marked with a number of straight lines.

Suppose the fiber in question is assumed to be rayon. It is sometimes possible to tell to which of the four kinds it belongs. Acetate silk is the only one which will dissolve in glacial acetic acid or acetone. (Caution—Do not heat acetone as it is inflammable). The acetic acid solution should be heated before coming to any conclusions. Pure silk is also dissolved by concentrated acetic acid. If the rayon belongs to the nitrocellulose group it will develop a blue color upon being immersed in a sulphuric acid solution of diphenylamine, which is prepared by dissolving 1 gram of diphenylamine in 100cc of concentrated sulphuric acid. Or one may dissolve the fiber in concentrated sulphuric acid and then add a trace of the dry diphenylamine. The characteristic blue color develops immediately.

Viscose may be also differentiated from cuprammonium silk as follows: Dissolve 1 gram of silver nitrate in 100cc of water. In a separate beaker dissolve 4 grams of sodium thiosulphate ("hypo") in 100cc of water. Add the silver nitrate solution to the thiosulphate. The cloudiness will disappear. Then add 100cc of a 4% sodium hydroxide solution (4 grams per 100cc of water), bring to a boil, cool, and filter. Immerse the thread in this reagent, boil for one minute, and observe. Cuprammonium silk remains unstained, whereas viscose assumes a brown or reddish brown color, and nitro-cellulose a brown color.

The Bureau of Standards in Washington, D. C. has evolved a fairly satisfactory test for differentiating the different kinds of rayon. This scheme is too difficult for the home chemist, however, inasmuch as the solutions must be made up fresh each time they are used, and must be prepared very accurately with the aid of a sensitive balance. The solution used is essentially a solution of iodine in concentrated sulphuric acid. When treated with this reagent viscose silk turns dark blue, acetate silk turns yellow,

(*Continued on page* 167)


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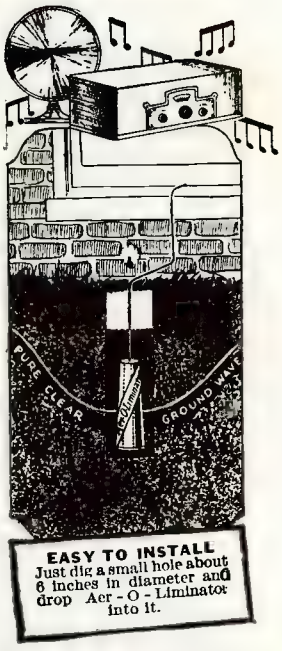


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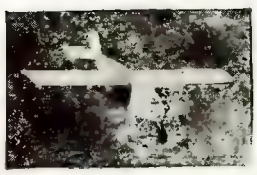

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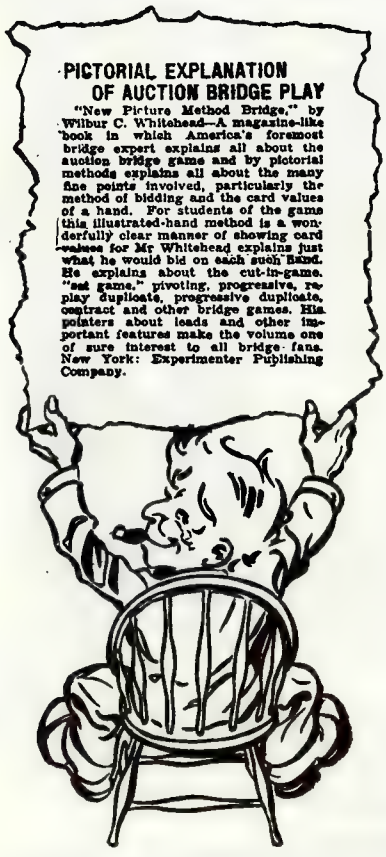
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"New Picture Method Bridge," by Wilbur C. Whitehead—A magazine-like book in which America's foremost bridge expert explains all about the auction bridge game and by pictorial methods explains all about the many fine points involved, particularly the method of bidding and the card values of a hand. For students of the game this illustrated-hand method is a wonderfully clear manner of showing card values for Mr Whitehead explains just what he would bid on each such hand. He explains about the cut-in-game, "set game," pivoting, progressive, replay duplicate, progressive duplicate, contract and other bridge games. His pointers about leads and other important features make the volume one of sure interest to all bridge fans. New York: Experimenter Publishing Company.

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# WHY BIG DAMS BURST

By H. WINFIELD SECOR

(*Continued from page* 107)

even though several geologists had informed him that the mica schist mentioned by Mr. Petit was usually made up of hard mica particles held together by a more or less soluble mixture or inter-filling, that the engineers who selected the site for the dam would never have consented to build the dam on such a poor foundation. It was the opinion of this authority on dam construction that the mica schist encountered at the location of the St. Francis Dam was undoubtedly a very hard form of conglomerate rock, a material with which he had come in contact many times in his travels. In other words, it was this expert's opinion that the engineers who selected the site of this great dam, and who supervised its construction, were satisfied that, according to the best engineering traditions, this dam could be relied upon to hold its position and permanently stay the twelve billion gallons of water, which were impounded behind it at the time of its collapse. In other words, as a man who had built many huge dams and also who had visited the scene of the collapse of one large dam, he stated that it was his unbiased opinion that he would be willing to wager his life and reputation; the same as did Mr. Mulholland, the dam's constructor, that this gigantic pile of concrete would stand immovably as a barrier against the waters which it was calculated to imprison.

### EARTHQUAKES AND OTHER CAUSES

MANY people who are familiar with the prevalence of earthquake tremors in California, have formed their own opinion as to the reason why the St. Francis Dam failed. In other words, they have blamed a local earthquake shock or tremor for the collapse of the dam. Some have conjectured that a prior shock might have weakened the dam. One of the engineers consulted by the writer, stated that he did not think an earthquake could have been the cause of the disaster, for the reason that in California particularly, there are many seismographs installed for recording earthquake tremors, and as there had apparently been no such manifestations recorded at the time of the dam's collapse, this theory seemed to be incorrect. Another theory which the public press made much of for a short time, was to the effect that the dam might have been dynamited. This theory has been discounted practically one hundred per cent by the authorities to whom we are indebted, as a very large amount of dynamite would be required to rupture a mass of concrete as large as that constituting the St. Francis Dam. One of the experts told the writer that he had built a large concrete dam in Mexico a number of years ago, and that even though the bandits had dynamite in their possession, they were never able to damage the structure.

One of the engineering experts responsible for the construction of the St. Francis Dam, stated early in the investigation of the disaster, that he believed the collapse of the dam was due to a series of major land slides above the dam. Several experts, who inspected the scene of the late water reservoir, reported finding evidence of three slides above the dam; which might have poured earth into the reservoir lake and caused the water level to rise suddenly, finally forcing the dam to give way. This statement is very misleading, as it rather gives the impression to the layman that just because some soil slid into the lake, and raised the water level, the dam burst because the water level suddenly rose to the top or near the top of the dam. In the first place, no competent engineer would design and build a dam, which was not strong enough to hold water behind it up to a level corresponding to the top of the dam. It would be the height of folly to design it otherwise, for he would always have to figure that nature might do the unexpected and through heavy rainfalls cause the water level to rise as high as the top of the dam. One of the hydraulic engineers we interviewed stated that this theory was all right, if a sufficient amount of soil had slid down into the reservoir, so as to cause an unusually large amount of silt or wet earth to pile up against the dam; and in this way it might create a sufficient hydrostatic pressure to cause the dam to collapse.

### POOR MATERIALS

IT hardly seems possible, according to the best expert opinion, that poor materials were responsible for the St. Francis Dam failure. Further investigation will eventually prove or disprove this theory. Some of the ways in which poor materials or the improper balance of materials may cause the collapse of such a huge concrete structure as this dam, will prove interesting, no doubt. In some cases non-reinforced concrete structures have failed because the contractors used too much sand and rock and not enough cement; in other cases, a poor quality of cement was used, or else the sand was of poor quality; in the case of one large dam failure, the collapse was finally traced to the nature of the rock, which had been crushed at the dam site and used as rubble in the concrete mixture. The dam collapse just cited, occurred some years ago in the vicinity of Lake Champlain. Naturally the rock found in the vicinity was carefully tested by the engineers and finally approved for use in this construction. The rock withstood the usual tests and did not appear to disintegrate or soften in the presence of water. After the collapse of the dam, it was found that wherever pieces of this rock used in the concrete mixture was covered with concrete, they remained hard and firm; but where the sun and water struck the rock, it disintegrated. Thus it was finally ascertained that the dam had collapsed because of the rock used in its construction.

One expert stated that he did not believe that the sand to be found in the vicinity of the St. Francis Dam was fit to use in mixing the concrete, if this sand had been used. His reason for making this statement was to the effect that the sand found in that part of the country was of a very peculiar nature, and liable, in his opinion, to be unstable when mixed with cement to form concrete, in an important and huge size structure, such as the St. Francis Dam; which it must be remembered, was under a tremendous strain as soon as the water was impounded at a reasonably high level behind it.

### DAMS SOMETIMES SKID

AS some of the accompanying drawings clearly show, the engineer who designs dams has a great many factors to consider. The St. Francis Dam is designed on what hydraulic engineers call "a gravity section." In other words, this dam, explained in a few words, is designed to be heavy enough to sit on its foundation and hold the impounded water behind it, by virtue of its gigantic mass of weight, and its consequent high inertia. The St. Francis Dam was built in the form of a combination arch—gravity section, as the photographs show. The arch shape is used to give added strength to the dam, as everyone knows that an arch is much harder to crush when the pressure is exerted downward upon it, than when a sim-

ple straight wall or other structure has pressure exerted upon it. With a gravity section dam, such as that employed in the California structure which caused such devastation when it failed, it is naturally quite important that the abutments or sides of such a dam be anchored in slots cut into the side rock walls of the valley; and this rock, moreover, must be of such a nature that it will not become honeycombed or disintegrate when water comes in contact with it, particularly when this water is under pressure. The pressure on each square inch at the inside base of the dam, and also on the bottom and sides of the reservoir for each foot-head of water, is .433 pounds. When one hundred feet of water is impounded behind the dam wall, the pressure per square inch is 43 pounds, and so on in proportion. Any increase in the length of the reservoir does not cause any greater pressure on the dam, but the pressure or strain on the dam and also on the rock to which it is anchored is increased in direct proportion as the water level rises.

In some of the drawings presented herewith, it will be seen how designers of dams have to calculate them of the proper weight and strength, so as not to be overturned by the weight and pressure exerted by the impounded water. Dams have frequently been overturned either vertically on the front toe, as one figure shows; or else they may skid around sidewise on a vertical axis, as one of the drawings illustrates.

It is interesting for the moment to consider a few of the different forms of dams which have and are being used for impounding large quantities of water, either for irrigation or power development purposes, besides the gravity-section type previously described. One of the principal types of dams now in favor is the arch type shown in one of the drawings, this particular design of dam obtaining its strength from the fact that it is curved in the form of an arch; the wall is quite thin, relatively speaking, much thinner than in the gravity-section type of dam. As the pressure of the impounded water is exerted against one of these arch type dams, the maximum resultant pressures are exerted on the abutments, strongly built at either side of the stream or valley.

A very odd type of dam, which is not so familiar to the layman perhaps, is shown in one of the accompanying drawings, and here an angular barrier wall made of wood, or in some cases concrete slabs, is placed at an angle of forty-five degrees. This barrier is supported on compression members made of wood, in some cases, or else of reinforced concrete, and as the water level rises the compression strain is taken by the poles or columns placed under the wall. A concrete base is placed under the columns; the concrete feet shown in the drawings are not used to prevent the dam skidding, so much as they are placed there to cut off water seepage through the earth.

It is interesting, in passing, to note that where these wedge-shaped dams or any other large concrete dams are built, that the huge mass of concrete is invariably divided into sections. to prevent cracks due to expansion and contraction. These concrete sections are locked together by means of female slots on the side of one unit, into which male ribs or projections on the side of the adjoining section fit. Heavy tar paper is placed between the sections before they are abutted, and when necessary a further waterproofing, such as tar, is poured over the inner side of the concrete wall.


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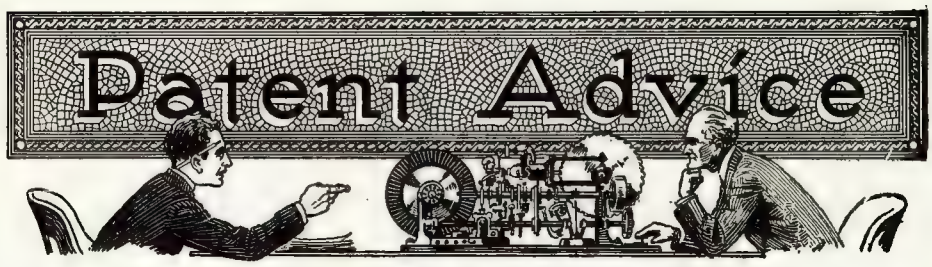


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**NOTE:—Before mailing your letter to this department, see to it that your name and address are upon the letter and envelope as well. Many letters are returned to us because either the name of the inquirer or his address is incorrectly given.**

### SEED PLANTER

(1091) Keith Jones, Irwin, Idaho, has designed a new seed planter, the naturc of which is not made clear in his description. He asks our opinion.

A. 1. There are on the market today many seed planters which plant seed in a predetermined order. Your plan is to do the same thing, but you have not made the method very clear. Before proceeding further with your suggestion, we would advise that you write to the various organizations in the United States supplying horticultural equipment and find out what they have in the line of seed planters. You will observe that some of these can take anything from millet to potato seed and that they can spread the seed anywhere from a few fractions of an inch apart to several feet. Most of the control is through the wheels. Careful investigation may save you much regret.

### GASOLINE TURBINE

(1092) Geo. Scholey, Tucson, Ariz., has designed a gasoline turbine comprising an explosion cylinder leading to an outlet which, in turn, directs the force of the exploded gases against the blades of the turbine. He desires our advice.

A. 1. The idea of a gasoline turbine is by no means new and in May 1920 we described a gasoline turbine with a large explosion chamber, an intake, a force feed, a spark gap and turbine blades, which latter were not made the way indicated by you, but were the blades of the Tesla turbine. Dr. Tesla possessed another advantage in his mechanism in that there was no valve, either exhaust or intake. The gas trickled in through a continuously open port and when the explosion took place, the peculiar arrangement of the valve caused a portion of the explosive stroke to react against itself, making the mechanism operate much the same as a Maxim silencer for explosions, except that this valve choked the explosive force in addition to choking the noise. The result was that his turbine could be worked up to extremely high speeds, the explosions occurring so rapidly after each other that a humming sound was produced.

The gasoline turbine is not as efficient as the gasoline engine because the full explosive stroke cannot be made to operate against a moving piston.

No doubt someone will eventually place a gas turbine on the market that will produce remarkable results, primarily because of its high speed and smoothness of operation; but to make it practical for the motor car, considerable gearing would have to be employed and this gearing is another objectionable feature.

Unless you are in a position to place the turbine on the market, and carry on extensive experimental work, we would advise against applying for a patent on the system, as we doubt if your idea will meet with any greater favor than existing and prior inventions.

### PHOTO-ELECTRIC CELL

(1093) James C. Tawer, Phoenix, Ariz., submits an idea for a photo-electric cell consisting of two aluminum foil plates, one side of each is polished and the other blackened. These are mounted rather loosely in an evacuated cylinder so that when the light strikes them, a difference in pressure is exerted by the light reflecting from the polished surfaces and being absorbed by the blackened surface. The plates thus moving together change the capacity of the cell and in turn communicate the reaction to an outside source.

A. 1. This idea seems to us to be quite novel and we would suggest that you experiment with it further. In our opinion a photo-electric cell made as designed would scarcely give satisfactory results. The principle on which you base your idea is that of the radiometer and the radiometer works by heat rather than light. Of course, there is no objection to your using an infra-red beam of light in place of quite a cold white beam. Nevertheless, it is doubtful if the plates will react rapidly enough to prevent the disadvantageous lag. Also, the question of inertia of the plates must be taken into consideration and these plates surely will not instantaneously return to their original positions, nor can you prevent a natural period of vibration.

We certainly suggest no further procedure in this action.

### VARIABLE AIRPLANE WING CAMBER

(1094) Bill Ingersoll, Ottumwa, Iowa, has designed an airplane wing, the lines of which can be constantly varied so as to compensate for different loads and assist in both take-off and landing. He asks our opinion.

A. 1. We are of the opinion that the variable wing camber of an airplane as designed by you might be of value and then again, it might not. It depends largely on your method of control, your ability to market the suggestion and the number of tests that you are going to carry out on this style of arrangement.

We certainly would suggest wind-tunnel tests and these should be made under practically normal flight conditions. There may be more in this suggestion than either you or I suspect, so before proceeding with application for a patent on the idea, we advise considerable experimentation. It might be worth your while.

### MUD SHOE

(1095) Albert Drapeu, Lewiston, Me., has designed a metal shoe provided with spikes which can be clamped directly to the rear wheels of an automobile and which the inventor believes will assist in bringing a mired automobile out of the mud.

A. 1. Your suggestion for an auto extractor is not entirely without merit, yet by no means would we call this a satisfactory method. An ordinary piece of rope brought around between the spokes, or several links of chain will serve the purpose as well. You must remember that teeth, regardless of their size, clog easily and quickly in soft mud and the device then gives no greater grip on additional muddy surfaces than that formed by any type of projection of similar thickness.

### RAILROAD RAIL

(1096) R. Land, Mt. Gambier, Australia, has designed a diagonally cut rail for railway systems, which abutting with another similarly cut rail, will to a great extent prevent non-alignment between adjacent rails.

A. 1. The idea which you have advanced in your communication concerning the method of connecting rail joints is by no means new. Why rails are not made in this manner is some-

(*Continued on page* 166)

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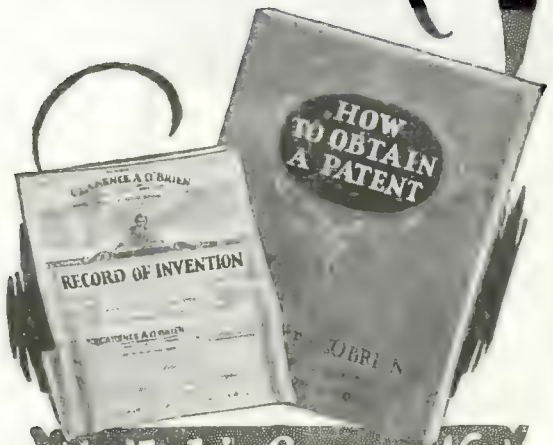


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## Patent Advice

(*Continued from page* 164)

thing difficult for one to determine because in one respect they do have some slight advantage over the square cut rails. On the other hand, a rail of this nature is more liable to be damaged because of the narrow cross-sectional area at either end. Perhaps this is the prime reason for their non-acceptance.

We do not believe that further action on your part will be of any material benefit.

---

**STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,**

of SCIENCE AND INVENTION, published monthly at New York, N. Y., for April 1, 1928.

State of New York, N. Y. } ss.
County of New York, N. Y. }

Before me, a notary public in and for the State and county aforesaid, personally appeared Hugo Gernsback, who, having been duly sworn according to law, deposes and says that he is the editor of SCIENCE AND INVENTION, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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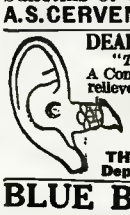

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## Of What Cloth is Your Suit Made?

(*Continued from page* 161)

nitro-cellulose silk violet, and cuprammonium silk light blue.

COTTON AND LINEN TESTS

We have still to consider cotton and linen. Since chemically these two fibers are practically identical when fully bleached, it is impossible to differentiate between them by chemical tests. Indeed, the only satisfactory method is by the use of the microscope. There are certain group tests, however, which we may use. Millon's reagent (mercury nitrate) is a reagent commonly used to detect the presence of proteins. The latter give a beautiful red color; carbohydrates are not affected. Applying this fact to our textiles, wool or silk, when covered with a few cubic centimeters of this chemical and heated gently, but not boiled, develop a characteristic red color in a very few minutes; cotton, linen and rayon remain uncolored. Perhaps your druggist will supply you with this reagent.

Another method of testing for proteins is to cover with concentrated nitric acid and bring to a boil. A yellow color develops which is intensified if, after pouring off the acid, and washing by decantation, concentrated hydroxide is added. Again wool and silk are the only textiles which respond to the test in this way.

If nitric acid is not part of your chemical set, and Milton's reagent is unavailable, you can still detect the presence of animal fibres versus vegetable fibers by using a solution of decolorized magenta. Prepare this reagent by dissolving 0.1 gram of magenta (fuchsin) in 100cc of water. Prepare sulphurous acid by adding hydrochloric acid to a solution of sodium bisulphite to full acid reaction. Add this solution of sulphurous acid to the magenta until the latter is just decolorized. Then immerse the fabric in question and boil. Remove and wash. Silk and wool assume a pink color; cotton, linen, and Rayon remain uncolored.

I would suggest that my reader familiarize himself with the tests mentioned in this article by trying them out on known textile fibers. A spool of sewing cotton and one of silk will give him his supply of cotton and silk fibers, a skein of wool his wool fibers. There are also skeins of embroidery silk now on the market made of rayon.

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## Answers to Scientific Problems and Puzzles

By ERNEST K. CHAPIN, M.A.

(*Continued from page* 126)

### THE CYLINDRICAL TANK

IF the boys started to climb up one side of the tank they would certainly put the tank into rotation due to the displacement of the center of gravity of the system from the center. This downward force due to their weight would be exactly balanced by an upward buoyant force which we must consider to act from the center of the cylinder. These two forces would constitute a couple which would produce rotation, but no general displacement of the tank. In order that there be any motion of the tank as a whole there would have to be an external force acting in some particular direction. But since the boys could not produce such an external force we cannot suppose the tank would move, except in rotation.

### THE VELOCITY OF THE FISH

Let V represent the velocity of the fish as he leaves the water; t, be the time he is in the air. Then $\frac{1}{2}V$ is his average velocity and the distance he jumps, 10 ft., is equal to av. vel. x time or $10=\frac{1}{2}Vt$. Also, since he looses 32.2 ft. per sec. each sec. under the action of gravitation, we see that $t=\frac{V}{32.2}$

$10=\frac{V^2}{2x32.2}$ and on solving for V, we find that the velocity of the fish must be over 25 ft. per sec. to make such a leap.

### THE RED HOT PENCIL MARK

All objects at temperatures above that of absolute zero are constantly in the process of radiating heat waves. They also absorb heat waves that reach them from surrounding bodies. When at equal temperatures, black bodies radiate more heat than white bodies. Hence a black pencil mark on a piece of white crockery will give out more heat than the crockery and therefore it will appear brighter than the crockery when both are red hot.

### THE ROCKING KETTLE OF WATER

Most kettles have, or at least soon develop, a slightly rounded bottom which makes it easy for it to rock somewhat when resting on a flat stove lid. Then because of unequal curvature of the base the bottom makes better contact with the stove at some certain point than it does at others. At this point there will be an expansion of the metal which will raise the kettle a little and tip it forward. As the water in the kettle follows the tipping motion it will still further aid in it and thus tip the kettle until some other point makes an especially good contact with the stove. An expansion of the metal at this point will now occur and the kettle will rock back into its former position. When conditions are just right the kettle may rock back and forth very vigorously until water issues from the spout each time the kettle tips forward.

### VIBRATION IN PARALLEL CONDUCTORS

A wire carrying an electric current is surrounded by a magnetic field; the magnetic lines of force being in concentric circles. When two conductors are parallel to each other the strength of this magnetic field is increased between the wires when the currents are in opposite direction but it is decreased between the wires when the currents are in the same direction. If a direct cur-


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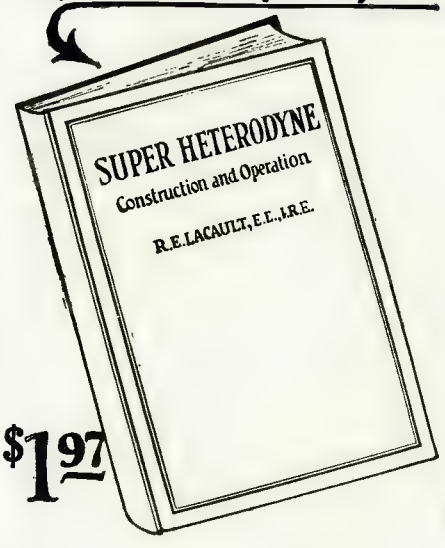


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rent be passing in one of the wires and alternating current in the other the field is alternately increased and decreased between the wires at a frequency exactly equal to that of the alternating current. The wires will then tend to approach each other and then recede from each other 60 times a sec. if we are using a 60 cycle A.C. and 30 times a sec. if we are using 30 cycle A.C. If the wires are tuned to a natural frequency of 60 or 30 the vibration will be encouraged by resonance. This tuning can be accomplished by changing the tension and length of the wires just as one tunes a violin string.

### ELECTRIC CELL IN FILLED TOOTH

There are three essential parts to an electric cell: two dissimilar elements, usually metals, and an electrolyte or solution that acts more readily on one of the elements than on the other. In a filled tooth the filling forms one of the electrodes of an electric cell, the saliva the electrolyte and the fork or spoon the second electrode. When the latter is touched to the filling the circuit is closed, the nerve of the tooth forming a part of the circuit, and the twinge of pain is consequently felt.

### KICKING INTO THE FUTURE

In the neighborhood of 180° longitude there is an imaginary line running north and south called the international date line. A ship crossing eastward over this line will set its time 24 hours back. If, for example it is nine a. m. Tuesday when it crossed the line it will be nine a. m. Monday immediately afterwards. On the other hand, if it is nine o'clock a. m. Monday on the east side of the line and the ship crosses to the west side it will then be nine a. m. Tuesday. It is now evident that to kick his poor dog 24 hours into the future, the ship must be in the act of crossing the date line when the captain makes his kick. And if the kick occurred on Dec. 31 the dog might be advanced not only into the following day, but also into the subsequent year.

### THE FLOATING ELECTRIC LAMP

The lamp in this stunt is connected to a spool of enameled wire. A current is induced in the spool of wire by means of an electromagnet concealed beneath the table, the magnet being supplied with an alternating current.

### THE RESISTANCE COILS

By connecting the coils two at a time in series the following resistances could be obtained: 5, 10, and 11 ohms. By connecting them in parallel we could get three more resistances: 1.2, 1.6, and 2.18 ohms. Then by connecting them three at a time all in series, all in parallel, or one in series with the other two in parallel, we can get five more combinations: 13, 24/23, 9.2, 4.6, 4.18 ohms. By connecting two in series and then placing this combination in parallel with the third coil we can get three more: 40/13, 30/13, and 22/13. These combinations together with the three that the coils give singly, make a total of 17 different possible resistances.

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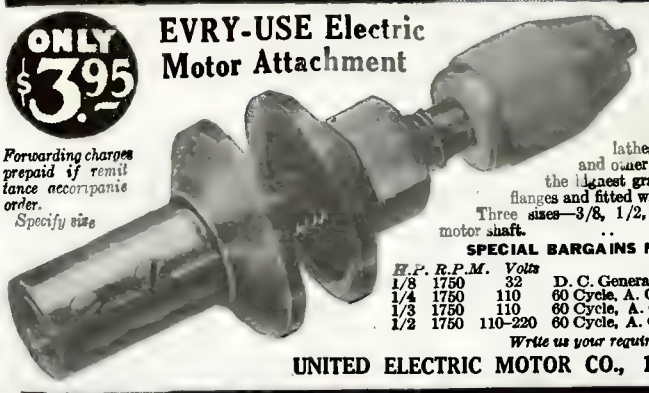

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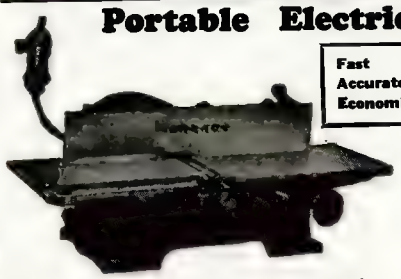

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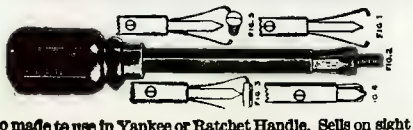

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## Double-Dovetail Cabinet Joints

By I. E. LOVETT

(*Continued from page* 137)

After planing the thickness down to ⅜ inch, make the sides 4¼ inches broad, and then cut the sides and ends to length.

Square up the ends and gauge for the dovetail joints, the gauge being set a distance exactly equal to the thickness of the sides; gauge in the usual way for a common dovetail in the first instance.

Fig. 13 shows a sketch of a corner of the box, giving the lines of the dovetail on a front and end. C is the front of the box and D is the end. Fig. 8 shows how the dovetails are to be set off on the ends of the front and back pieces of the box, and fig. 9 shows the outsides of the same pieces. The dovetails are double beveled as it may be expressed.

Have those marked off, saw in, and cut out with the chisel.

Fig. 11 shows the position of the sockets cut on the end pieces of the box, and fig. 10 shows the outside face of the ends, and fig. 12 gives the inside face. In fig. 10 and fig. 12 an extension cut out at a 45° slope is shown. This enables the dovetails to be put together. In laying out the end pieces draw on the pins of the sides in the usual way as for a common dovetail; these marks are to be squared over on the outside, as shown at Fig. 10; then with a bevel come in ⅛ inch and draw the sockets as shown in the solid lines (fig. 12.) The extensions enable the pieces to be put together.

The distance EE (fig. 12) is made equal to EE (fig. 8), and fig. 20 shows the section of the joint on the line BB, while fig. 19 is the section on line AA.

After the inner faces of the pieces have been cleaned and sandpapered, fig. 14 shows how the corners of the box are put together.

In preparing the top and bottom these have ¼ inch of projection over the sides and ends, and the ends of each of their pieces are mitred and cut out for a distance of ½ inch, in and cross end strips are fitted in; this addition will hide the end wood, and the joint of the cross ends will be covered by the inlay or (as shown in the design in fig. 1) by the raised panel on the top.

Glue the top and bottom in position and then saw the box in two.

Fit the top and bottom together and hinge the lid, using a good quality of brass butt hinges. The hinges are next unscrewed, to allow the finishing of the two parts of the box, the body and the top to be proceeded with. Fig. 1 shows lid with an inlaid raised panel.

The idea here is to build up this panel, gluing up strip 1¼ inch wide and two of ⅛ inch for the inlay, and two to be ⅜ inch broad.

These are to make a finished piece 2¼ inches broad and ⅜ inch thick.

Mitre and glue the pieces for the panel to the lid, they lay off on the four 1¼ inch sides to ⅛ inch on the outer edge, as shown in fig. 1

The lid of the box (fig. 2) has a ⅛ inch inlaid strip in a contrasting wood.

The box line is formed with key corners, with the inlay mitred throughout.

This goes along quite well with the central pattern, which consists of five diamonds; the size of this inlay is shown in fig. 18.

The inlay on the sides of the box (fig. 1) is also formed with diamond-shaped pieces inlaid in other wood; the dimensions of the pattern are given in fig. 17.

Each of the boxes is shown with small feet at the corners, the design for which feet is shown in fig. 16. The height is ¼

(*Continued on page* 173)


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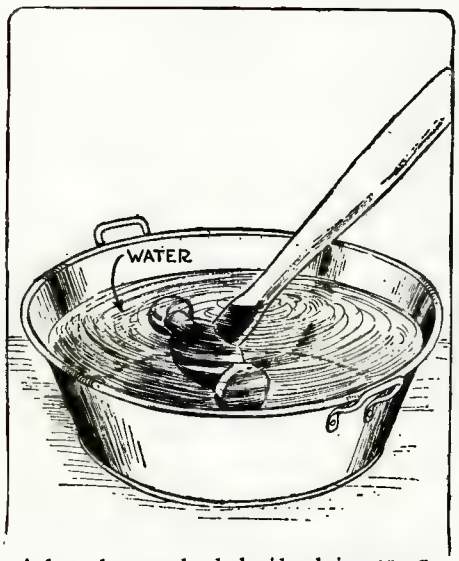
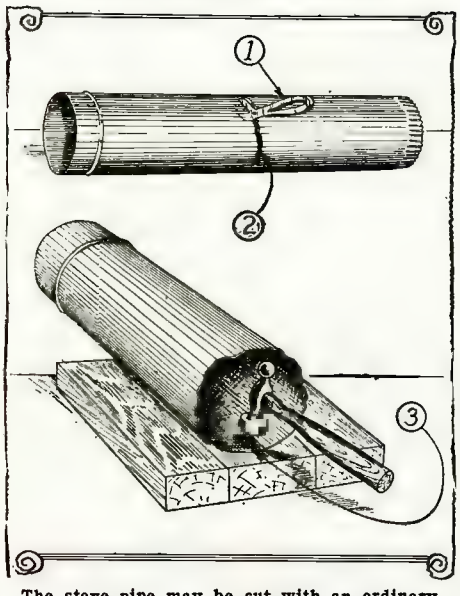


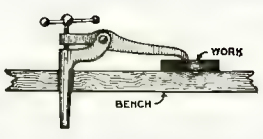

A loose hammer head, besides being an annoyance, is decidedly dangerous and should be repaired before it is used again. Such tools are generally repaired temporarily by hammering nails into the end of the handle; this method seems to be unsatisfactory in many cases. A very efficient, but little known method of tightening loose tool heads, is to soak the loose part in a pail of water overnight.—R. Wailes.

### CUTTING STOVE PIPE




The stove pipe may be cut with an ordinary can opener, as shown in the upper illustration. The resulting ragged edge can be smoothed out with a hammer and a block of wood, as shown. Tin snips are awkward to use in contrast to this use of the can opener.
G. H. Luers.

### HANDY BENCH CLAMP




A bench clamp constructed in the manner shown above will be found very useful, as it does not take long to attach it to the work bench, to remove it from the bench, or to clamp it down on the work. It is important not to have the supporting hole too large.—Contributor, send name and address.

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# If You Were Dying To-Night

and I offered something that would give you ten years more to live, would you take it? You'd grab it. Well, fellows, I've got it, but don't wait till you're dying or it won't do you a bit of good. It will then be too late. Right now is the time. To-morrow or any day, some disease will get you and if you have not equipped yourself to fight it off, you're gone. I don't claim to cure disease. I am not a medical doctor, but I'll put you in such condition that the doctor will starve to death waiting for you to take sick. Can you imagine a mosquito trying to bite a brick wall? A fine chance.

## A RE-BUILT MAN

I like to get the weak ones. I delight in getting hold of a man who has been turned down as hopeless by others. It's easy enough to finish a task that's more than half done. But give me the weak, sickly chap and watch him grow stronger. That's what I like. It's fun to me because I know I can do it and I like to give the other fellow the laugh. I don't just give you a veneer of muscle that looks good to others. I work on you both inside and out. I not only put big, massive arms and legs on you, but I build up those inner muscles that surround your vital organs. The kind that give you real pep and energy—the kind that fire you with ambition and the courage to tackle anything set before you.

## ALL I ASK IS NINETY DAYS

Who says it takes years to get in shape. Show me the man who makes any such claims and I'll make him eat his words. I'll put one full inch on your arm in just 30 days. Yes, and two full inches on your chest in the same length of time. Meanwhile, I'm putting life and pep into your old back-bone. And from then on, just watch 'em grow. At the end of thirty days you won't know yourself. Your whole body will take on an entirely different appearance. But you've only started. Now comes the real works. I've only built my foundation. I want just 60 days more (90 in all) and you'll make those friends of yours who think they're strong look like something the cat dragged in.

## A REAL MAN

When I'm through with you you're a real man. The kind that can prove it. You will be able to do things you had thought impossible. And the beauty of it is you keep on going. Your deep full chest breathes in rich, pure air, stimulating your blood and making you just bubble over with vim and vitality. Your huge square shoulders and your massive muscular arms have that craving for the exercise of a regular he man. You have the flash to your eye and the pep to your step that will make you admired and sought after in both the business and social world.

This is no idle prattle, fellows. If you doubt me, make me prove it. Go ahead, I like it. I have already done this for thousands of others and my records are unchallenged. What I have done for them, I will do for you. Come then, for time flies and every day counts. Let this very day be the beginning of new life to you.

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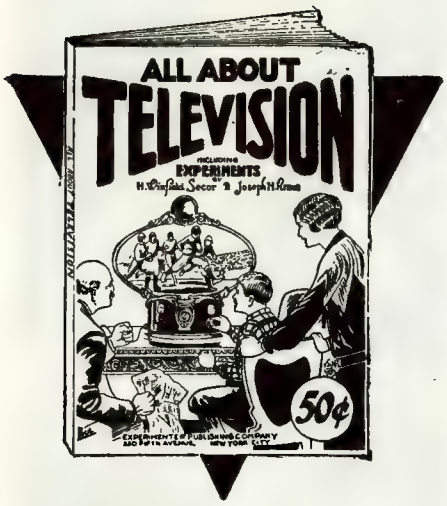


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## BOOK REVIEWS

(*Continued from page* 160)

ESSAYS IN POPULAR SCIENCE. By Julian Huxley, Professor of Zoology in the University of London. Stiff cloth covers. 316 pages. 8¾ x 6 inches. Published by Alfred A. Knopf, New York. Price $4.00.

Have you ever thought about death? Do you wonder why you have red hair when your father and mother are blondes or brunettes? Have you given much thought to the subject of heredity? Why do more boy babies die than do those of the opposite sex?

These are questions that have occupied the minds of thinkers for many decades and there is no doubt whatsoever that any man or woman, who gives any consideration to the things of life, other than what he shall eat and drink to-morrow, has wondered about these subjects and many others, that Prof. Huxley considers in his book of essays. For example in the chapters headed, "Heredity" and "The Inheritance of Acquired Characters," these subjects of wide interest are discussed in a clear manner in reference to the functioning of the chromosomes, their mutations and the operating of the Mendelian law.

Throughout the entire book the author tells of biology in language, which although not technical, is not "textbooky," and will interest the lay reader who likes to think for himself. A great amount of material appears on the effect of the glands in different animals, especially in the frog and the tadpole. This subject is an important one, as the glands of animals are gradually teaching us what effects similar glands in the human body have on its development. Relatively little is known today about the glands in proportion to their importance in the growth of the body and Prof. Huxley tells in a clear way what is known.

Although this book is written for the lay reader yet unless the man has an interest in the deeper things of life our advice is to steer clear of the book. But if you are interested in the whys and wherefores of heredity, glandular development, biology and kindred subjects, then get this book and read it, for you will find it written in a style both pleasing from a literary as well as scientific viewpoint. The glands are adequately treated here.—*G. C. B. R.*

MOTHER INDIA, by Katherine Mayo. Stiff cloth covers, 6" x 9", 41 illustrations, 440 pages. Published by Harcourt, Brace & Co., New York City. Price, $3.75.

One of the important books of the year without a doubt is this remarkable narrative by Katherine Mayo, a description of sociological conditions in India as she personally witnessed them. Every true student of medical science, general philosophy and sociology must not fail to read this work.

One can hardly realize, even after reading the very interesting and authoritative treatise on India's sociological conditions, that such a state of affairs could exist, only three weeks' sailing distance from America's shores. One of the greatest points of scientific and philosophic interest brought out by the author, is the fact that child marriage is the usual thing in India. Aside from the fact that in most parts of the world today, it is not considered the regular and best thing to do in marrying a child wife nine years of age; there is another interesting and potent factor to conjure with, namely, the fact that the majority of the child wives bearing children are found venereally diseased. The few British hospitals with English and American doctors and nurses are doing all they can in the face of the intense religious antagonism of the Indian people. As the author points out, proper antiseptic treatment at child birth, not to mention the modern treatment of ordinary wounds and illnesses, is practically unknown in India, except in a few British hospitals in the large cities. No wonder then that in India each generation sees the death of 3,200,000 mothers in the agonies of child birth.

Due to the powerful ancient religious rites practiced in India, and the hatred of people from other countries who are endeavoring to educate these people to the modern hygienic way of living, the fight against the gigantic mountain of ignorance existing in this country of three hundred and eighteen million people, is a very slow one. It has been computed that it will take one hundred years before the people in India will have learned how to live as more enlightened peoples of other countries do.

The author quotes British hospital records in India to show that even though women in tropical countries are supposed to mature at a much earlier age than those in more northern climes, it is scientifically wrong to expect the little child wives, of which India has millions, to give birth to a child properly at an age of ten or eleven years, and some of them younger. The human body is not matured physiologically, in the bony structure, to undergo such a strain, with results which we cannot state here, but which you can read in the medical reports given in this remarkable book. Most interesting of all, in one aspect, is the fact that Indian men who have been sent to England and other countries and educated in the best universities, such as Oxford, have gone back to India and married according to their basic religious teaching, a child wife possibly nine years old or less. Famous Indian scholars who know the sociological conditions in their country, make brave speeches with regard to doing away with the child wife problem and other undesirable aspects of Indian life, but they make these speeches at government meetings in the large cities; they dare not go back to their home towns or cities and preach these doctrines, for they know that the religious attitude taken by their fellow men would spell political disaster and possible death for them. —*H. W. S.*

WE, by Charles A. Lindbergh. Stiff cloth covers, 5½" x 8¼", illustrated, 318 pages. Published by G. P. Putnam's Sons, New York City. Price, $2.50.

This book is a story of the famous flier's home life and his trans-Atlantic flight, together with his views on the future of aviation. Flying was Colonel Lindbergh's trade, and he has announced that he will devote himself wholeheartedly to the advancement of aeronautics. "We" is his first literary step in that direction, and no one can doubt that its influence will be of great value in furthering man's conquest of the air. The author tells us in his interesting manner of his boyhood early flights and of his first plane. He reviews his flying experiences year by year until he finally makes the flight from New York to Paris. At the close of the book, Fitzhugh Green has written a brief account of Lindbergh's various receptions in the different countries, and those given him in Washington, New York and St. Louis.—*P. W.*

CHEMISTRY OF FAMILIAR THINGS, by Samuel Schmucker Sadtler, S. B. Stiff cloth covers, 5½" x 8¾", illustrated, 330 pages. Published by J. B. Lippincott Co., Philadelphia, Pa. Price, $3.00.

Edward Slosson, in a sense, started the ball rolling, in the direction of popularizing chemistry. The present book is a good deal in that line. It opens with a rather clever presentation of the theory of chemistry; one of those things which can be read with benefit by all of us and then, after giving some generalities, takes up one subject after another; the chemistry of the geologic processes of the earth; the chemistry of different metals, of alkalies and salts. These subjects are followed by organic chemistry and the chemistry of the human body, fermentation, including the production of wine, soap, paper, leather, glass, etc. It makes a very attractive book, and it is a compliment to say that we think it deserves a better index than that which has been assigned to it.

**IN "RADIO NEWS" FOR JUNE, 1928**

**Across the Frontiers of Europe by Radio—By Golda M. Goldman**
**Radio Takes Over the Geography Class—By C. P. Mason**
**The How and Why of Radio Filters—By Fred H. Canfield**
**How Many Stations on One Wavelength—By J. H. Barron, Jr.**
**Radio Measures Human Nerve Impulses—By T. A. Hunter**
**How to Build the Neutroheterodyne—By H. J. Reich**
**Radio Brain Translates Scrambled Speech—By G. C. B. Rowe**

## READERS FORUM

(*Continued from page* 145)

**height of the patient was increased.. There is no scientific proof that this ever takes place, but the curve can be taken out of the spine and the curve, likewise, be removed from the cervical or neck region by standing erect. Just try it yourself; stand against the wall and stretch your neck and you will see yourself increase at least an inch and one-half in height. Testimonials of subjects 18, 19, 20, and even 22 years can be discounted, because bone growth doesn't always cease in some individuals until the age of 25. A few experiments will surprise you.—EDITOR.)**

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## Double-Dovetail Cabinet Joints

(*Continued from page* 170)

inch; and to avoid showing end wood each foot is built of two parts mitred.

Internally the box is filled with a tray, a section of which is shown in figs. 6 and 7.

Fig. 7 shows the end of the tray resting on a bearer glued to the end of the box.

Fig. 16 gives a dimensioned sketch of this piece, which is of a length to fit tightly between the two sides. This bearer piece covers up the extension of the dovetailed sockets in the inside of the box. Where a tray is not required, fit angle fillets in the internal angles of the box, which will cover up the notches in the same way.

In making the tray the material is ⅛ inch thick; dovetail and glue the joint, and cut out in the ends the finger grips shown in fig. 6.

Fit the box with a small box lock, making the plate of the lock flush with the inside of the box.

## MOTOR HINTS

**CONDUCTED BY GEORGE H. LUERS**

(*Continued from page* 131)

gear shift, this finger makes contact with the side of the lever when placed in reverse. A small reflecting light, such as a four-inch spot light, is mounted on the rear tire rack.

Electric connections are made through the battery circuit.

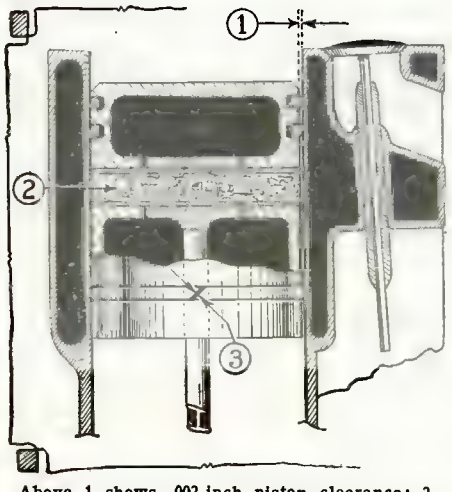
### FITTING OVERSIZE PISTONS

When the warm weather of early summer thins the engine oil and clouds of smoke issue from the exhaust, this is indicative of worn pistons and rings.

Pistons are usually obtainable .0025 inch, .005 inch and .025 inch oversize, and usually the engine will take the first or .0025 inch oversize piston.

If this fits the bore with a clearance of .002 inch, it is satisfactory, but closer than this it should be lapped in with grinding compound. Fit the piston rings, trying these in the cylinder bore and filing off at the gap, until a clearance of one-hundredth inch is obtained. In determining these clearances, use standard thickness gauges and do not depend upon the feel of the parts.

When the parts are ready for installing, fill each wrist pin with graphite and heavy oil. This graphite and oil will prevent the new pistons sticking and also nullify the cutting which might be caused by any of the grinding compound remaining. The grinding compound, however, should be thoroughly cleaned before installing the pistons.




Above 1 shows .002-inch piston clearance; 2, wrist pin hole filled with graphite and oil; and 3, a clearance of .01 inch at joints of piston rings.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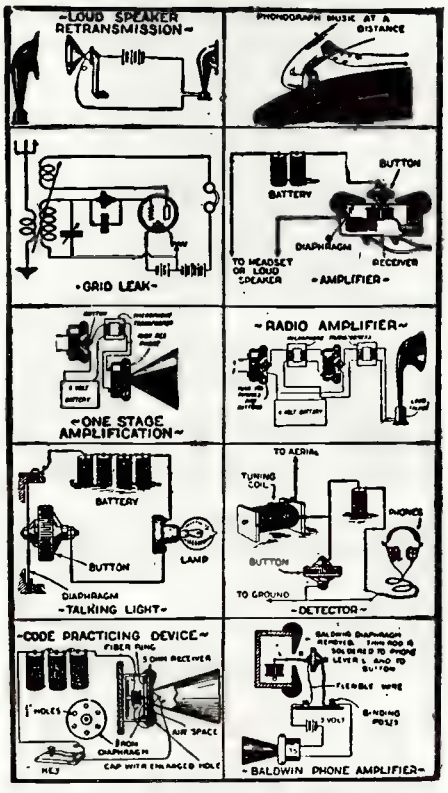


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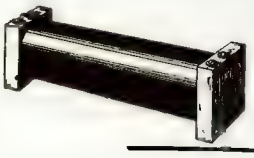

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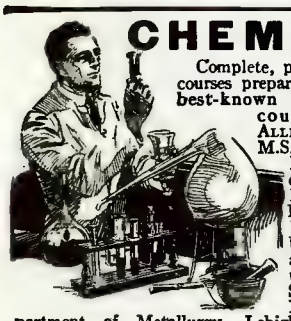

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## New Belin Photo-Transmitter

By LUCIEN FOURNIER

(*Continued from page* 119)

### RECEPTION AND TRANSMISSION SIMPLIFIED

IN the receiving system we find again the same cylinder as that used in transmission, driven always by a phonic wheel motor but enclosed in a dark chamber; this too is pierced by a small hole to permit the entrance of the "receiving" ray of light.

It is enough now to retransform the electric modulations caught by the receiving antenna or else by the ordinary telegraphic wire so as to get luminous modulations therefrom.

On the cylinder there is rolled a sheet of ordinary photographic paper, its sensitized surface being outside, so that the luminous ray entering the dark room leaves its tra upon this paper.

The currents are first received by an amplifier which sends them finally into a reflecting oscillograph set. This last, whose inertia is almost zero, is subject to these currents making slight horizontal oscillations. If a luminous ray touches it, the reflecting ray will increase its oscillations which are received on a glass screen before penetrating into the optic system, which causes the ray to penetrate into the dark chamber through the hole made in its face.

Now suppose that a manuscript is being received. The mirror will cause a slight displacement to right or left upon the screen of the ray. This has a very narrow slit through which the ray passes when at rest, the opaque portion of this screen cutting the ray off when it moves away from the slot.

It is easy to see that under the action of the current reaching the oscillograph, the luminous ray will be deviated and will not penetrate into the optic system. During the periods of repose the ray will pass through this optic system and will affect the sensitized paper.

If the cylinders are turning in synchronism each will present at the same instant the same points of the same generatrix before the luminous rays, and the point touched by the ray from the transmitter will take the same position on the receiving cylinder. All the points will succeed each other regularly, the reproduction of the writing will be obtained on the sensitized paper.

In the transmission of a photographic image, the same phenomena occur but the mirror will be actuated by variable oscillations. The opaque screen will then be replaced by a screen of graduated transparency,—already utilized in the former apparatus—and the light ray which penetrates into the dark chamber will find itself modulated exactly in the same conditions as those of the reflected ray from the transmitter.

The sensitized paper will register these modulations to reproduce all the tints of the original photograph in their exact value.

Now a few words regarding the maintenance of synchronism.

### SYNCHRONIZATION

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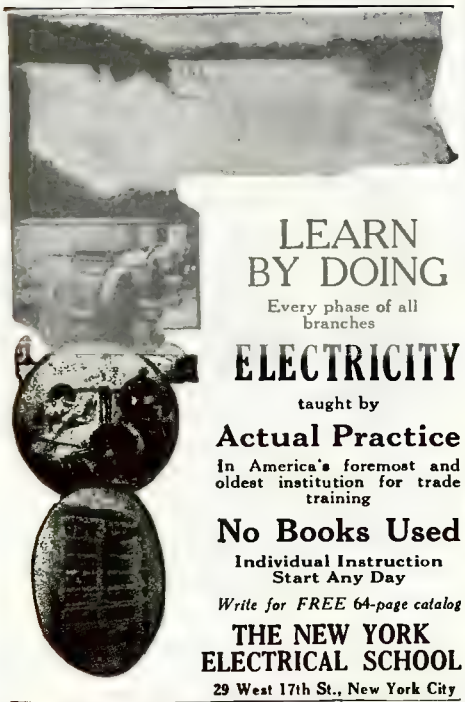

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from a tuning fork, driven electrically by an electro-magnet placed between its legs, and it is these last which send and shut off alternately the currents. As the legs of two tuning forks giving the same note produce exactly the same number of vibrations per second, it is easy to see that the two motors receiving these vibrations will turn at the same speed, though they may be 500 or more miles apart. Here we have one condition realized—perfect synchronism of the two cylinders.

We need only say that the two cylinders emit at the beginning luminous spots which appear upon the screen placed in front of the transmitting system and the spots approach nearer and nearer until they blend. At this moment the cylinders are at the same point or synchronized, and the two apparatus are allowed to operate normally.

The tests on a telegraph line of these new apparatus will soon take place. The results obtained will govern the putting the invention into actual service, and the carrying out of telegraphic transmission of photographs and autographs, limited at present to exceptional requirements, which will become of general application in the conduct of business.

## X-rays Aid to Industry

By HERBERT R. ISENBURGER

(*Continued from page* 118)

conditions are perhaps more prevalent in the case of castings, they also occur with forgings as well as bar or plate stock. In all these cases X-ray inspection would eliminate faulty conditions within the material.

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## Simple Experiments in Botany

By RAYMOND B. WAILES

(*Continued from page* 132)

The interior of a jar in which a rose slip had taken root, acquired a temperature 14 degrees higher than that of the outside air. This experiment is shown above.

If two rose leaves are smeared with grease on their upper surfaces, the holes on the underside will not be affected and the water in the leaves will be quickly expelled through the stoma, and the leaves will crumple and wither. If a leaf is coated on its underside, it will remain fresh for a long time. Above photo shows this clearly.

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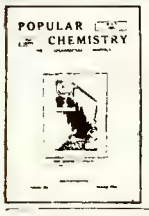


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## Making and Using Garden Sprays

By DR. ERNEST BADE

(*Continued from page* 133)

this substance kills the plants. In dilute solutions, in which it is used as a spray, it is deadly to all forms of lower plant life among which plant diseases are found.

One of the best fungicides is the Bordeaux mixture which is made with copper sulphate and milk of lime. A stock solution which is later diluted for use, is prepared by dissolving one pound of copper sulphate in a gallon of water. Then, in another vessel, slake one pound of burned lime, calcium oxide, with one gallon of water. Add the water very slowly and stir vigorously. Never add the water rapidly, this "drowns" the lime. Keep each of these two solutions separately in bottles. When used for spray, take forty parts of water for each part of copper sulphate solution. This means for each ounce of copper-sulphate solution to use 40 ounces of water and add one ounce of the lime solution. When made up the Bordeaux mixture consists of a solution and a precipitate. The former is calcium sulphate and the latter is a basic copper sulphate which is insoluble.

For delicate plants an excess of lime is advisable, for it prevents copper burn. The mixture should always be freshly mixed just before it is to be used and it is advisable to test for free copper. This is accomplished by pouring a few drops of a concentrated water solution of potassium ferrocyanide into a glass of the freshly prepared spray mixture. If a reddish brown precipitate is formed, more lime must be added. Remember that an excess of lime does no harm while an excess of copper may cause burning of the leaves.

Another efficient fungicide is the lime-sulphur mixture. This is prepared by slaking one pound of burnt lime, calcium oxide, with one gallon of water. Then add two pounds of flowers of sulphur and boil the mixture for an hour. Smaller proportions may be used and are just as effective, in this or any other formula. Strain out the lumps and bottle the liquid. For use dilute the stock solution with 9 parts of water and spray before or after the leaves have made their appearance. In summer, when the plants are in full foliage, each part of the stock solution is diluted with forty parts of water (each ounce with 40 ounces of water.) At this period of the year the spray also acts as a contact insecticide.

One of the most common contact insecticides used for the soft bodied sap-sucking pests is kerosene emulsion. Dissolve two ounces of soap in a pint of water with the aid of heat preferably in a double saucepan. Then, while the soap is still hot, take it off the fire, add one quart of kerosene and churn or shake vigorously until a perfect emulsion is formed. This is the stock solution. Keep in a bottle and label. When it is to be used, take note of the type of insect to be controlled. For scale insects use one ounce of the stock solution and dilute it with nine ounces of water and spray. For ordinary sap-sucking insects 15 ounces of water are taken for each ounce of stock solution, while for the control of the soft bodied plant lice 20 ounces of water are used for each ounce of emulsion. Spray the infested plant until it is wet, but do not carry this process so far that puddles collect on the ground. The plant should be wet, but the moisture should not drip.

Poison sprays are dependent upon their action in controlling pests by the habit of the insect which eats part of the plant and in order to be effective, the poison must be

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sprayed upon the plant upon which the creature is feeding so that it absorbs a certain amount with its food and dies.

The arsenical compounds have replaced practically all other types of sprays for masticating insects, and of these the arsenate of lead and the arsenite of lime have replaced the older Paris green as being much safer to use. Arsenate of lead will not injure the most delicate plant and is therefore one of the best types of sprays to use. It consists of three parts (by weight) of crystallized sodium arsenate mixed with seven parts of lead acetate. These substances, when pulverized, readily unite and form a white precipitate of lead arsenate which is kept more readily in suspension than any other poison. Anywhere from one to five ounces of this substance can be mixed with two gallons of water to make an effective spray.

The stock solution of arsenite of lime, calcium arsenite, is prepared differently. Boil one ounce of white arsenic with four ounces of sodium carbonate in half a pint of water for twenty minutes or until dissolved. One ounce of this stock solution, which will keep indefinitely, is mixed with 8½ gallons of water in which three ounces of burned lime have been carefully slaked. Keep the stock solution plainly labeled and keep it away from prying hands.

## How Hot is the Moon?

By DONALD H. MENZEL, Ph.D.

(*Continued from page* 124)

ing took place is almost incredible. In the space of but a few hours there was a fluctuation of 200°, from a temperature approximating to that of boiling water to a value far colder than any spot on the earth has ever experienced.

This can mean but one thing: that the rock which forms the lunar mountains, plains, and valleys has but little heat content. In spite of the blazing sun and sizzling outer layers, the radiation does not penetrate far below the surface. Dig down but a short distance and it is probable that you would find extreme cold. How hot is the moon? We set out to answer this question and find values ranging from the regions exposed to the blistering solar heat to the other extremes of frigidity where only the most sensitive and accurate of thermal instruments could detect the existence of a temperature at all. If some great catastrophe could destroy both the oceans and the atmosphere of our earth, we too, stripped of our protecting garments, would, like the moon, alternately experience burning sunshine and frozen darkness. Fortunately, there is no likelihood of such an event befalling the earth. I said "fortunately," but that implies a selfish and certainly self-centered point of view, for of what importance is life among the celestial orbs! Can we rightly call the moon less fortunate than the earth simply because its surface is not infested with the organic scum which we call life! In our own experience do we prefer the moldy crust to the one unaffected by bacterial vegetation!

For this last rambling paragraph I shall have to beg the indulgence of the reader, for I have indeed wandered far from the domain of the astronomer. We were speaking of the moon. The next time you see our satellite in its natural haunts, whether sailing in nocturnal splendor, or paled before the sun, recall these facts regarding the lunar temperature and physical condition and ask yourself whether its charm is lessened at all by the fact that some of its mysteries have been uncovered. To most people, the stars are interesting because of their mystery. Astronomers, on the other hand, take their delight in solving celestial puzzles and, in their conquest of space, have gained another citadel—we now know how hot the moon is.


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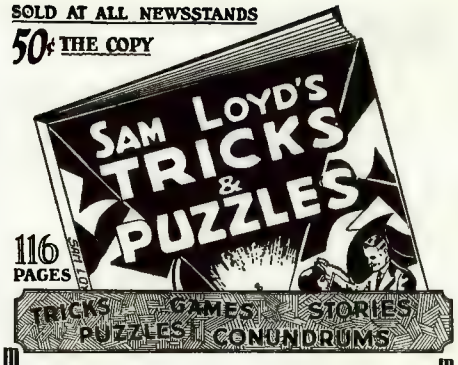


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## Mysteries of the Air

(*Continued from page 120*)

ally its hemispherical shape, but the upper side becomes as flat as the surface of a lake. The air (Fig. 1, IV) separates beneath the drop and presses down on its upper surface in a sudden whirl around it. There, where the wind currents indicated on each side—in reality we are dealing with a closed ring shape current—comes together, there is a

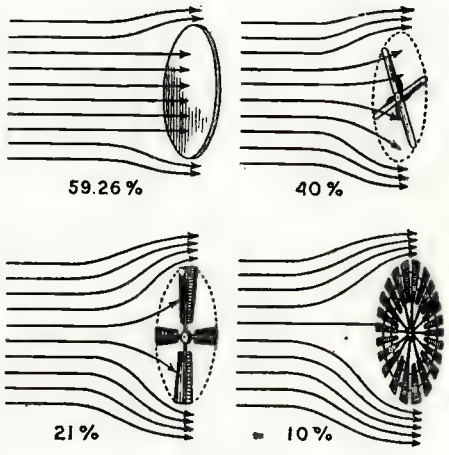


FIG. 6

**The efficiencies of individual air power machines vary greatly. Of the wind pressure, which a true disc (above on the left) can receive under the most advantageous circumstances, the venti-motor only gets about two-thirds, the wind-mill (left, below) about one-third, and the wind-turbine (right, below) one-sixth part in efficiency.**

neutral volume of air indicated by the dotted space. Before the little point hanging from the faucet (Fig. I, III) can draw itself completely back, this little whirlwind tears from it a minute drop and it now closely follows the original drop as a satellite and as its moon. The eye cannot discover the minutiae, but the quick-seeing camera has caught for us this second surprise. Yes, and more! The drop takes a characteristic form V, changes back to the form IV, and continues to fall and remains between these two forms. Why is this so?

A hollow copper ball (Fig. I, VI) is placed upon a little tube connected with a pressure gauge and is brought into a similarly shaped current of air of the wind tunnel. If a small hole is drilled at the point *a*, the pressure gauge shows no wind pressure, but on the contrary a certain amount of suction, while a higher pressure is only found when we reach the point *b*. The curves drawn around the ball in Fig. 1, VI, indicate the relations of suction and pressure. From the middle of the under surface of the falling drop the air accordingly draws out the little projection, Fig. 1, V, so that the continual effort of the drops to take a spherical form is again opposed. The battle between two forces of nature has to follow the water in its descending course.

FIG. 4

**The small disc, blown against perpendicularly, experiences the same air resistance as the stream line airship body.**

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### A SIMPLE AIR EXPERIMENT

TO those who consider my statements quite too fantastic I would recommend a simple little experiment. A small round piece of cardboard, *a*, Fig. 2, is impaled on a smooth knitting needle and is secured with a drop of ambroid or other glue. The other disk *b* is not cemented, but by repeated moving back and forth on the needle, is made to slide along it with little resistance. This disk *b* can be made somewhat larger than *a*, and yet it will not fly backward when one blows in the line of the knitting needle in the direction of the arrows, against the two, but is actually sucked back towards *a*. With an audible "clap" it strikes against *a* when one changes the space between the two disks a little so as to accurately determine the point of reversal of the air current. This suction increases the wind pressure on the disk some fifty per cent. The force of the air current, depending on the diameter of the disk, can be calculated from the known weight of air of about 1.225 kilograms per cubic meter, and on the velocity. The operation of the pressure depends very closely on the form of the body. The Zeppelin shaped object following the streamline shape, experiences a much slighter resistance (Fig. 3). Our Fig. 4 shows a small white disk of cardboard and a large Zeppelin model and both of these experience the same air resistance.

From all the above interesting observations the results of my investigations on wind power machines are only hinted at. I was the first who established wind power investigations and curiously enough the manufacturers of air power machines took four years to follow me.

The wind pressure on a motionless "windwheel," Fig. 5, is powerful. The wheels are called air turbines. Unfortunately they are often destroyed by storms. On the right of the "Ventimotor" (wind motor), as I have named the propeller-like object, only one-third of the wind pressure is found. If a windmill is turning a great part of the pressure disappears or escapes. The operation of the windmill is thus exactly the reverse of the Ventimotor. If these sort of wings are stationary the wind passes between the widely separated arms freely, but the quicker they turn the more wind do they catch, so it is a mistake from the wind pressure, as known, to draw any conclusion about the operation of different wind power machines. From the dotted contour of the air current in Fig. 6, theoretical conclusions will give nothing contrary to the statements of this article, in the best case 59.26 per cent of the air power is absorbed. If the wind cannot go through the wheel, it goes around it, the best possible arrangement; the employment of rotors or other well developed arrangements gives no better result. The Ventimotor is always the best in results. It will never be possible to get the full 59.26 efficiency out of it because the wings not only absorb power but also do useless work to force the air back of the wheel into spiral motion or to produce sharp changes in direction, and so forth. In this respect the wind turbine is the worst. In a good plant of this kind, in England, I could hardly find more than 7 per cent efficiency. If we take away the framework and make a sort of a windmill, and have no more than twelve wings, we will at once get some thirty per cent efficiency.—*K. Bilau in "Die Koralle."*


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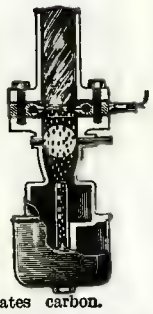

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## The Metal Emperor
By A. MERRITT
(*Continued from page* 129)

armored, carrying small shields and led by Kulun. Their bearers stopped well within the platform, and lowered their burdens. The leader of those around the second litter drew aside its covering.

Out stepped Ruth and after her—Ventnor.

"Martin! Ruth!" we cried. Ventnor raised his hand in greeting, and I thought he smiled.

The cubes on which we stood shot forward, and stopped within a score of feet of them. Instantly, the guard of swordsmen raised their blades and held them over the pair, as though waiting signal to strike.

And now I saw that Ruth was not clothed as when we had left her. She stood in a scanty kirtle that came scarcely to her knees, her shoulders were bare, her curly brown hair unbound and tangled. Her face was stamped with wrath hardly less than that upon Norhala's. On Ventnor's forehead was a blood red scar, a line that ran from temple to temple like a brand.

The curtains of the first litter quivered. Behind them some one spoke. The litter in which Ruth and Ventnor had ridden was drawn swiftly away. The knots of swordsmen drew back. Into their places sprang and knelt a dozen archers. They ringed the man and maid, bows drawn taut, arrows in place and pointing straight to their hearts.

Out of the litter rolled a giant—seven feet he must have been in height. Over the huge shoulders and the barreled chest hung a purple cloak glittering with gems. Through the thick and grizzled hair passed a flashing circlet of jewels.

The scarlet armored Kulun beside him, swordsmen guarding both, he walked to the verge of the torn gap in the wall. He peered down it, and glanced appraisingly at the hammer-handed arms. Then with Kulun he strode over to the very edge of the broken parapet and stood, head thrust a little forward, studying us in silence.

"Cherkis!" whispered Norhala. "Cherkis!"

I felt her body quiver. A hot desire to slay passed from her to me as I looked at the face staring at us. It was a mask of evil, of cold cruelty and of callous lusts. Black slits of eyes glared at us between pouches that held them half closed. Heavy jowls hung pendulous, dragging down the corners of the thick lipped brutal mouth into a deep graven, unchanging sneer.


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The face was the lair of every beast of sensuality. As he gazed upon Norhala, a flicker of lust shot like a licking tongue through his eyes.

Yet within him I sensed power; sinister, instinct with evil, concentrate with cruelty—but power.

Norhala broke the silence.

"*Tcherak!* Greeting—Cherkis!" There was merciless mirth in her voice. "Lo, I did but knock gently at your gates, and you hastened to welcome me! Greetings—swine, spittle of the toads, fat slug beneath my sandals!"

He passed the insults by, unmoved—although a murmuring went up from those near, and Kulun's hard eyes blazed.

"Let us bargain, Norhala," he answered calmly.

"Bargain!" she laughed. "What have you with which to bargain, Cherkis?"

"I have these," he waved a hand toward Ruth and her brother. "Me you may slay—and mayhap many of mine. But before you can move, my archers shall feather the hearts of those two like the birds."

"God!" muttered Drake. "He can do it!"

Norhala considered him, no longer mocking.

"Two who were dear to me you slew long since, Cherkis," she said finally. "And therefore I am here."

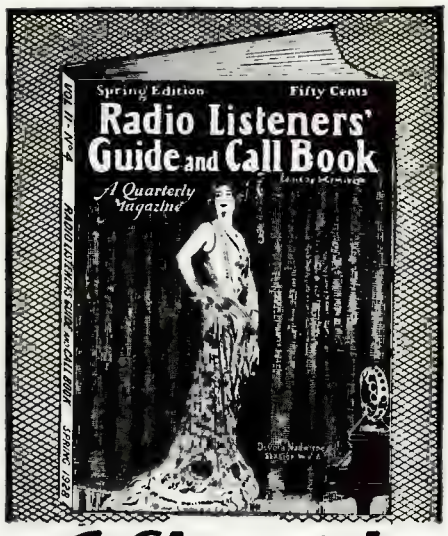
"I know," he nodded heavily. "Yet what of that now, Norhala. It was long since, and I have learned much during the years. I would have killed you too, Norhala, could I have found you. To-day I would not do as then—quite differently would I do, Norhala; for I have learned much. I am sorry that I killed those you loved. I am in truth sorry."

**"There was a quick trembling through the waiting spindle. Down swung its sledges. Down fell the smitten walls, shattered and crumbling, and with them, flittering like shining flies in a dust storm, down fell those who manned them. . . ."**

There was a lurking sardonicism in the words, an undertone of mockery. Was it that he really meant that in those years he had learned to inflict greater agonies, more exquisite tortures? If so, Norhala apparently did not sense the interpretation. Indeed, she seemed to be interested, and her wrath abating.

"No," the hoarse voice rumbled on dispassionately. "None of that is important—now. You would have this man and girl. I hold them. They die, at my nod. They die if you stir a hand's breadth toward me. If they die, I prevail against you—for I have cheated you of what you desire. I win, Norhala, even though you slay me. That is all that now is important."

There was doubt upon Norhala's face.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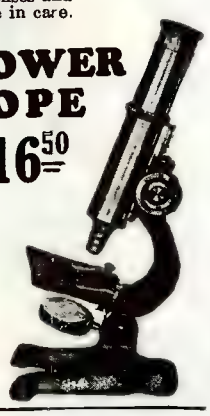

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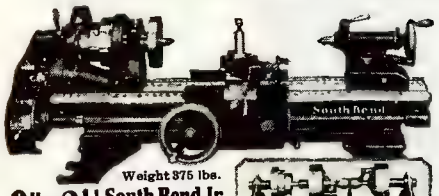


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I caught a gleam of contemptuous triumph in the depths of the evil eyes.

"Empty must be your victory over me, Norhala," he said, and waited.

"What is your bargain?" she spoke hesitantly. With a sinking of my heart I heard doubt tremble in her voice.

"If you will go without further knock upon my gates"—there was a satiric grimness in the phrase—"If you will go when you have been given these two, and pledge yourself never to return—you shall have them. If you will not, then they die."

"But what security, what hostages, do you ask?" Her eyes were troubled. "I cannot swear by your Gods, Cherkis, for they are not my Gods. Why should I not say yes to you and take the pair; then fall upon you and destroy—as you would do in my place, old wolf?"

"Norhala," he answered, "I ask nothing but your word. Did I not know those who bore you and the line from which they sprung? Was not always the word they gave kept till death—unbroken, inviolable? No need for vows to Gods between you and me—O glorious daughter of kings, princess royal."

The great voice was harshly caressing. Not obsequious, but as though he gave her rightful honor. Norhala's face softened. And a wholesome respect for this man's mentality came to me. It did not temper, it heightened, the repulsion I felt for him. But I applauded, impersonally, the subtlety of his attack, realized that unerringly he had taken the only means by which he could have gained a hearing.

"It is true," she answered proudly. "Though why you should dwell upon this, Cherkis, whose word is steadfast as the running stream and whose promises are as lasting as its bubbles—why you should dwell on this I do not know."

"I have changed greatly, Princess, in the years since my great wickedness. I have learned much. He who speaks to you now is not he you were taught—and taught justly then—to hate," he said.

"You may speak truth! Certainly you are not as I have pictured you." It was as though she were more than half convinced. "In this at least you do speak truth—that if I promise, I will go and molest you no more."

"Why go at all, Princess?" Quietly he asked the question. Then drew himself to his full height, threw wide his arms.

"Princess?" the great voice rumbled forth. "Nay—Queen! Why leave us again—Norhala the Queen? Are we not of your people? Am I not of your kin? Join your power with ours. What that war engine you ride may be, how built, I know not. But this I do know—that with our strengths joined we two can go forth from here where I have dwelt so long, go forth into the forgotten world, eating its cities as we will, and rule!

"You shall teach our people to make these engines, Norhala, and we will make many of them. Queen Norhala—you shall wed my son Kulun, he who stands beside me. And while I live you shall rule with me, rule equally. And when I die you and Kulun shall rule.

"Thus shall our two royal lines be made one, the old feud wiped out, the long score be settled. Queen—wherever it is you dwell, it comes to me that you have few of men. Queen—you need men, many men and strong to follow you, men to gather the harvests of your power, men to bring to you the fruit of your smallest wish—

"Young men and vigorous to amuse you—

"Let the past be forgotten—I too have wrongs to forget, O Queen! Come to us, Great One, with your power and your beauty! Teach us! Lead us! Return, and throned above your people, rule the world!"

He ceased. Over the battlements and over all the city dropped silence—as though


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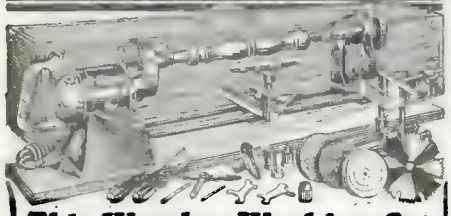

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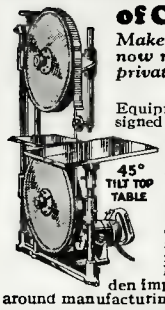


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the city knew its fate was hanging upon the balance.

Through my veins ran prickling terror. Not this hidden place, not its forgotten people, not even the fate of us four from the outer world concerned me. What lay upon the scales was the fate of the whole outer world, the destinies of humanity!

"No! No!" It was Ruth crying. "Do not trust him, Norhala! It's a trap! He shamed me—he tortured—"

Cherkis half turned. Before he swung about I saw hell shadow his face. Ventnor's hand thrust out, covered Ruth's mouth and choked her crying.

"Your son"—Norhala spoke swiftly, and back flashed the cruel face of Cherkis, devouring her with his eyes. "Your son—and Queenship here—and Empire of the World!" Her voice was rapt, thrilled. "All this you offer to me—Norhala?"

"This and more!" The huge bulk of his body quivered with eagerness. "If it be your wish, O Queen, I, Cherkis, will step down from the throne for you and sit beneath your right hand, eager to do your bidding!"

She studied him a moment.

"Norhala," I whispered, "do not do this thing. He thinks to gain your secrets."

Her hand dropped, and caught me by the wrist.

"Let my bridegroom stand forth that I may look upon him," called Norhala.

Cherkis relaxed, as though a strain had been withdrawn. Between him and his crimson-clad son flashed a glance, as though a triumphant devil sped from them into each other's eyes.

I saw Ruth shrink into Ventnor's arms. Up from the wall rose a jubilant shouting. It was caught by the inner battlements, and passed on to the crowded terraces.

Ruszark rejoiced!

"Take Kulun." It was Drake, pistol drawn and whispering across to me. "I'll handle Cherkis. And shoot straight."

## CHAPTER XXVI

### THE VENGEANCE OF NORHALA

Norhala's hand that had gone from my wrist dropped down again and held it. The other fell upon Drake's.

Kulun loosed his hood and let it fall about his shoulders. He stepped forward, and held out his arms to Norhala.

"A strong man!" she cried approvingly. "Hail—my bridegroom! But stay—stand back a moment. Stand beside that man for whom I came to Ruszark. Fain would I see you side by side."

Kulun's face darkened. But Cherkis smiled with evil understanding, shrugged his shoulders, and whispered to him. His son stepped back. The ring of archers lowered their bows. They leaped to their feet, and stood aside to let him pass.

Quick as a serpent's tongue, a pyramid tipped tentacle flicked out beneath us. It darted through the broken circle of the bowmen. It licked up Ruth and Ventnor and—Kulun!

Swiftly as it had shot forth it returned. It coiled, and dropped those two I loved, eyes tight closed, bodies quivering, at Norhala's sandals.

It flashed back to the wall with the scarlet length of Cherkis's son sprawled along its angled end.

Cherkis seemed to wither. Up from all the city that could see went a sigh of horror.

Out rang the merciless chimes of Norhala's laughter.

*"Tchai!"* she cried. *"Tchai!* Fat fool there! *Tchai!*—you Cherkis! Toad whose wits have sickened with your years. Did you think to catch me, Norhala, in your filthy web? Princess! Queen! Empress of Earth! Ho—old fox I have outplayed and beaten, what now have you to trade with Norhala?"


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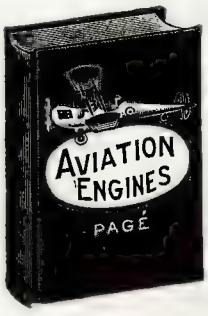


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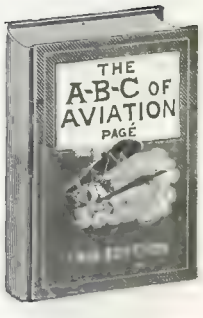


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Mouth sagging, eyes glaring, he raised his arms—a suppliant.

"You would have back the bridegroom you gave me?" she laughed. "Take him then!"

Down swayed the metal arm that held Kulun. And glad, glad was I that Ruth's eyes were closed against Drake's breast.

For the metal arm dropped Cherkis's son at Cherkis's feet—and as though Kulun had been a ripe grape—it crushed him.

Before those who had seen could stir from their stupor, the tentacle hovered over Cherkis, glaring down at the horror that had been his son. It did not strike him—it drew him up to it as a magnet draws a pin. And as the pin swings from the under side of the magnet, so did Cherkis from the pyramid that held him. Hanging so he was carried toward us, came to a stop not ten feet from us!

Weird, weird beyond all telling was that picture. The swinging gross body of Cherkis in the clutch of the tentacles, his arms half outstretched, the gemmed cloak flapping like the wings of a bat, his white, malignant face. The city from which pulsed almost visibly a vast hopeless horror. The watching column—and, over all, the palely radiant white sky under whose light the encircling cliffs were tremendous stony palettes splashed with a hundred pigments—

Norhala's laughter ceased. She looked upon Cherkis, and drank of the despair in his eyes.

"Cherkis!" she whispered. "Now comes the end for you—and for all that is yours. Until that end's end you shall see!"

The hanging body was thrust forward, was thrust upward, was brought down upon its feet on the upper plane of the prostrate pyramid tipping the metal arm that held him. For an instant Cherkis strove to escape, to break from what must have been to him an incredible restraint. I think he meant to hurl himself down upon Norhala, to kill her before he himself was slain.

If so, after that one frenzied effort he realized the futility, for with a certain dignity he drew himself upright and turned his eyes toward his city.

Over that city hung a dreadful silence.

"The end!" murmured Norhala.

There was a quick trembling through the waiting spindle. Down swung its sledges. Down fell the smitten walls, shattered and crumbling, and with them, flittering like shining flies in a dust storm, down fell those who manned them.

Through a mile-wide breach and up to the inner barrier I glimpsed a confusion chaotic.

Again I say it—they were no cowards, those men of Cherkis. From the inner battlements flew clouds of arrows, huge stones—as uselessly as before.

Out from opened gates poured regiments of horsemen, brandishing javelins and maces, and shouting as they drove down upon each end of the spindle. Under cover of their attack I saw cloaked riders spurring their ponies across the plain to the shelter of the cliff walls, to the chance of hiding-places there. Women and men of the rich flying for safety. After them ran and scattered through the fields of grain a multitude on foot.

The ends of the spindle drew back before the horsemen's charge, broadening as they went like the heads of cobras withdrawing into their hoods. With lightning velocity the broadenings expanded into immense lunettes, into two tremendous crab-like claws. Their tips flung themselves past the racing troops. Then, like gigantic pincers, they began to contract.

Of no avail now was it for the horsemen to halt, dragging their mounts down upon their haunches, or to turn to fly. The ends of the lunettes met, the pincer tips closed.

The mounted men were trapped within half-mile-wide circles. And in upon man

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and horse the living walls of these circles marched. Within those enclosures of the doomed began a frantic milling.

There was a dreadful screaming of horses, a shrieking of men. Then silence. Where the mounted men had been was—nothing!

Nothing! There were two great circular spaces whose floors were glistening and wetly red. Fragments of man or horse—there was none. They had been crushed, stamped even as Norhala had promised, into the rock beneath the feet of her—servants.

I looked away, sick. My eyes fell upon a Thing that writhed and undulated over the plain, a prodigious serpentine shape of cubes and spheres, linked and studded thick with the spikes of the pyramids. Playfully it sped and twisted among the fugitives, crushing them, tossing them aside broken, writhing over them. Some hurled themselves upon it in impotent despair. Some knelt before it. On rolled its metal convolutions, inexorable.

Within my vision's range there were no more fugitives. Around a corner of the broken battlements raced the serpent shape. Where it had writhed was now no waving grain, no trees, no green thing. There was only smooth rock upon which here and there red smears glistened.

There was a crying. In its wake a rumbling—the column at work upon the further battlements. As though the sound had been a signal, the spindle trembled. We were thrust up another hundred feet or more. Back dropped the host of brandished arms, and threaded into the parent bulk.

Right and left of us the spindle split into scores of fissures. Between these fissures the Horde geysered. Block and sphere and pyramid spun and swirled. There was an instant of formlessness.

Then, right and left of us, stood scores of giant, grotesque warriors. Their heads were full fifty feet above Ruszark's wall. They stood upon six immense, columnar stilts. These supported, a hundred feet above their bases, a huge and globular body formed of clusters of the spheres. Out from each of these bodies sprang half a score of colossal arms shaped like flails, like spike-studded girders; Titanic battle maces, Cyclopean sledges. From legs and trunks and arms the tiny eyes flashed, exulting.

There came from them a chorus of thin, eager wailings like hounds at cry. There pulsed through all that incredible battle-line a jubilant throbbing.

With a rhythmic, jocund stride we leaped upon the city.

Under the mallets of the smiting arms the inner walls fell as under the hammers of a thousand metal Thors. Over their fragments we strode, grinding stone and man together as we passed.

All of Ruszark except the side hidden by the mount lay open to my gaze. In a brief moment of pause I saw crazed crowds battling in narrow streets, trampling over mounds of the fallen, surging over barricades of bodies, clawing and tearing at each other in their flight from the nightmare invaders.

There was a wide, stepped street of gleaming white stone that climbed, an immense stairway, straight up the slope to that broad plaza at the top where were clustered the great temples and palaces—the Acropolis. Into it the streets of the terraces flowed. There poured out upon it living torrents tumultuous with tuliped, sparkling little waves—the gay coverings and the rams and armor of Ruszark's thousands seeking safety at the shrines of their gods. . . .

Here great carven arches arose, there slender, exquisite towers capped with red gold. There was a street of colossal statues; another over which dozens of graceful fretted, mysterious bridges threw their spans from feathery billows of flowering trees. There were gardens gay with blossoms in

(*Continued on page* 188)


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## The Metal Emperor

By A. MERRITT

(*Continued from page* 186)

which fountains sparkled. Green groves. Thousands of bright banners fluttered.

A fair, a lovely city was Ruszark. Its beauty filled the eyes. From it streamed the fragrance of its gardens.

And the voice of its agony was that of the lost souls in Dis.

The row of destroying shapes lengthened, each huge warrior drawing far apart from its mates. They flexed their manifold arms, shadow boxed—grotesquely, dreadfully.

Down struck the flails, the sledges. Beneath the blows the buildings burst like eggshells, their fragments burying the throngs fighting for escape in the thoroughfares that threaded them.

Over their ruins we moved.

Down, ever down crushed the awful sledges. And ever under them the city crumbled.

There was a spider Shape of Norhala's folk that crawled up the wide stairway, hammering into the stone those who tried to flee before it.

**Bull throat and barrel chest racked by his sobbing, Cherkis watched the annihilation of his people and his city. . . . Coldly, Norhala watched him.**

Stride by stride we ate up the city!

I felt neither wrath nor pity. Through me beat a jubilant, roaring pulse as though I were a shouting corpuscle of the hurricane, as though I were one of the hosts of bellowing spirits of the typhoon. Through this tumult stole another thought—vague, unfamiliar, yet seemingly of Truth's own essence. Why I wondered, had I never recognized it before? Why had I never known that these green forms called trees were only ugly, unsymmetrical excrescences? That these high projections of towers, these buildings were—deformities? That these four-pronged, moving little shapes that screamed and ran were—hideous?

They must be wiped out. All this misshapen, jumbled, inharmonious ugliness must be wiped out.

It must be ground down to smooth, unbroken planes, harmonious curvings—harmonies of arc and line and angle.

Something deep within me fought to speak—fought to tell me that this thought was not human thought, not my thought.

That it was the reflected thought of the Metal Thing!

Fiercely it struggled to make me realize what it was that it told. Its insistence was


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borne upon a little, despairing, rhythmic beating. Louder, closer came the throbbing. Clearer, with it, beat my perception of the inhumanness of my thought.

The drum-beat tapped at my humanity. It became a dolorous knocking at my heart.

It was the sobbing of Cherkis!

The gross face was shrunken, the cheeks sagging in folds of woe. Cruelty and wickedness were wiped from it. The evil in the eyes had been washed out by tears. Bull throat and barrel chest racked by his sobbing, Cherkis watched the annihilation of his people and his city.

And relentlessly, coldly, Norhala watched him, as though loath to lose the faintest shadow of his agony.

Now we were close to the top of the mount. Packed between us and the structures that crowned it were thousands of the people. They fell on their knees before us, prayed to us. They tore at each other, striving to hide themselves in the mass that was themselves. They beat against the barred doors of the sanctuaries. They climbed the pillars. They swarmed over the golden roofs.

There was a moment of chaos—a chaos of which we were the heart.

Then temple and palace cracked and burst. They were shattered. They fell. I caught glimpses of gleaming sculptures, glitterings of gold and of silver, flashing of gems, shimmering of gorgeous draperies—and under them a weltering of men and women.

We closed down upon them.

The dreadful sobbing ceased. The head of Cherkis swung upon his shoulder, his eyes closed.

The Destroying Things touched. Their flailing arms withdrew into their bodies. They joined, forming for an instant a tremendous hollow pillar far down in whose center we stood. They parted, shifted in shape, and rolled down the mount and over its ruins like a widening wave.

Afar away the gleaming serpent was still at play, still writhing, still obliterating the few score scattered fugitives that somehow had slipped by the Destroying Things.

* * *

At the outer rim of what had been Ruszark we halted. For one long moment Norhala looked upon the drooping body of Cherkis.

Then the metal arm whirled. The cloaked form flew outward like a great blue bat. It fell upon the flattened mount that had been the proud crown of his city.

A blue blot upon desolation, the broken body of Cherkis lay.

A black speck appeared high in the sky; grew fast— the *lammergeier*.

"I have left carrion for you—after all!" whispered Norhala.

With a swirling of wings the vulture dropped beside the blue heap and thrust into it its beak.

(*To be continued*)

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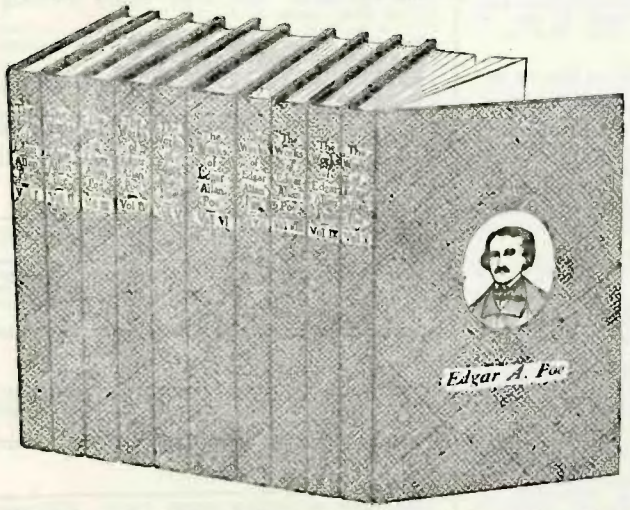


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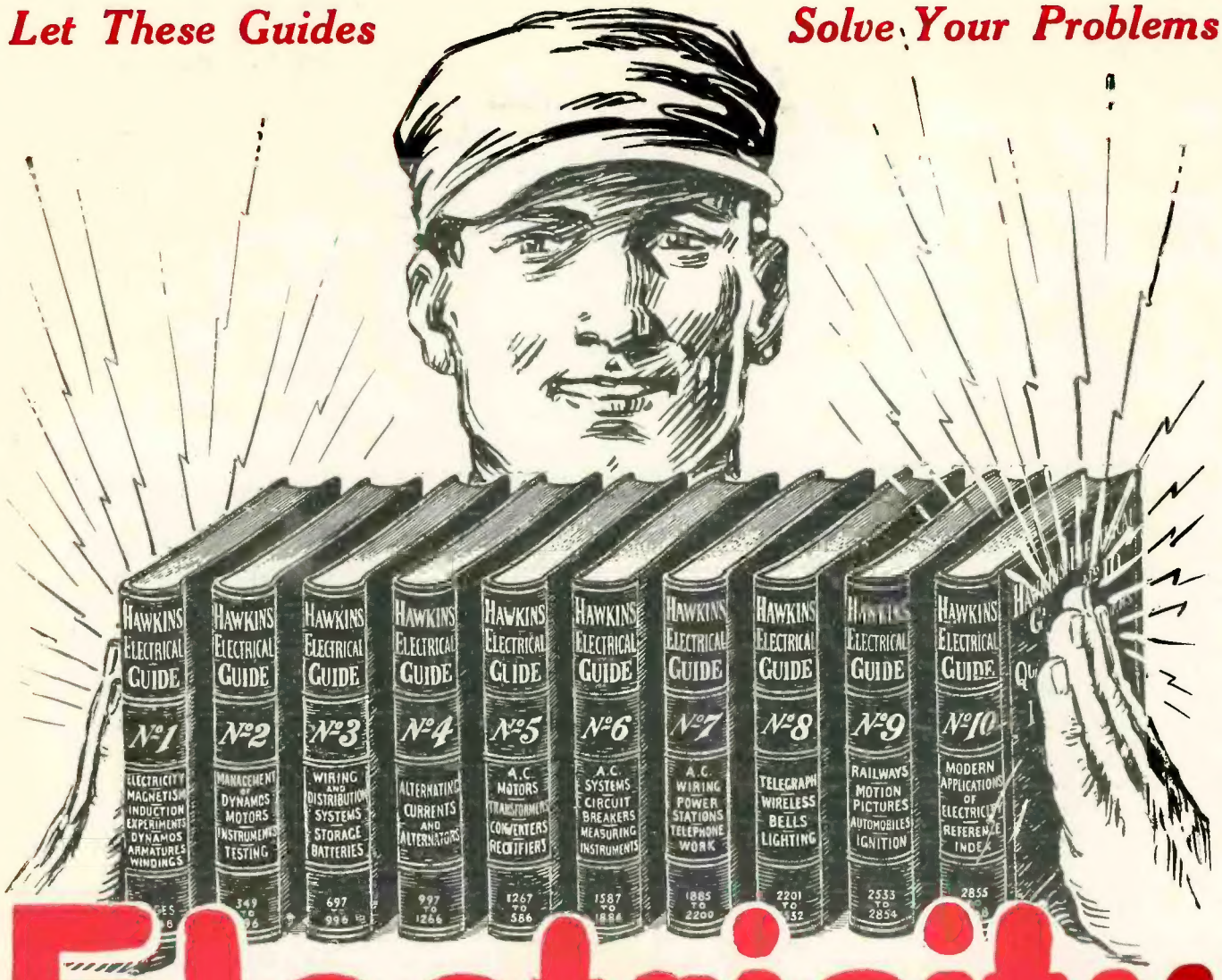


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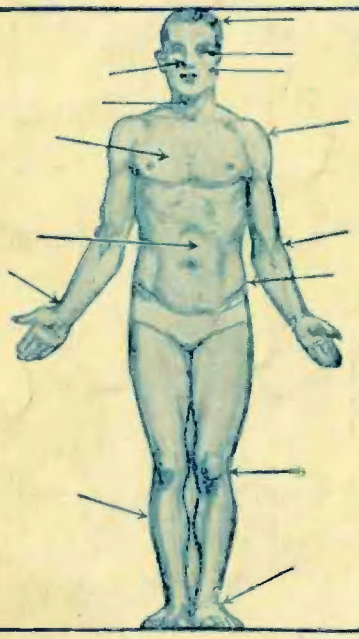

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